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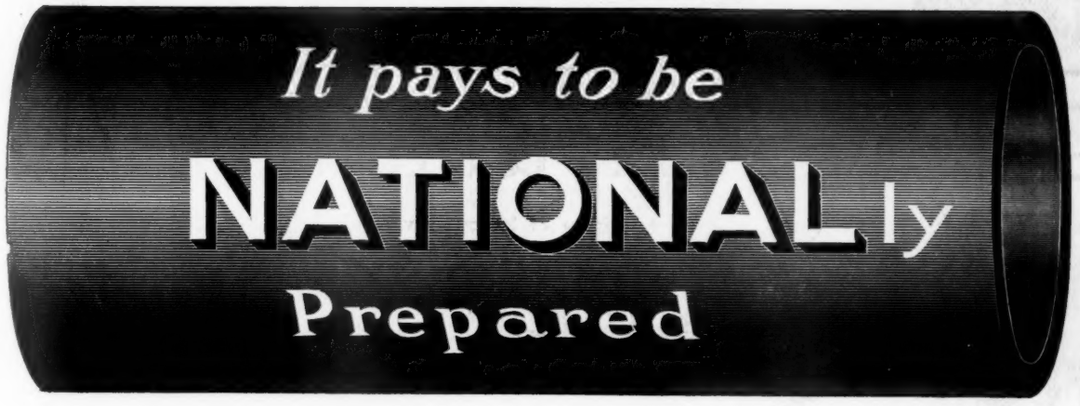

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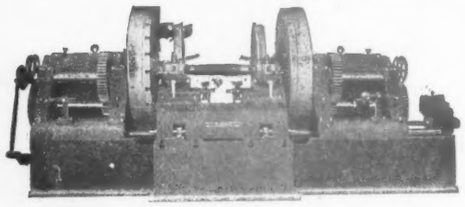

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Then, too, it insures clean-cut, well formed threads due to the **variable rake angle** which permits of a grinding suitable for any material.

Our new catalogue No. 22 contains not only a description of the Landis die but also valuable threading information. Write for a copy.

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Designed for every variety of drop forging work,

ERIE STEAM DROP HAMMERS

fulfill the most exacting requirements of railway work.

The valve motion may be automatic for continuous striking; controlled by a self-acting valve gear, having a sliding contact on the ram by a cam. Any desired blow, from a single dead blow to a light finishing blow is easily obtained.

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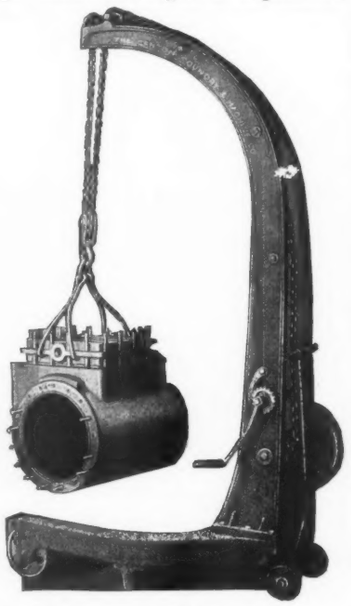

Fifty odd railways using it, nothing odd about that when you consider that it enables one man to quickly handle the heaviest parts. Invaluable for rapid, efficient work in your round houses.

One Man's Labor Against Six

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CANTON OHIO, U. S. A.

Railway Mechanical Engineer

Volume 90 June, 1916 No. 6

What is Heat Treated Steel?

On page 111 of the March issue of the *Railway Mechanical Engineer* we announced that a prize of $35 would be awarded for the best article, and a prize of $25 for the next best article submitted on heat treated steel. The competition closed on May 1, and the first prize has been awarded to Lawford H. Fry. Mr. Fry is with the Standard Steel Works Company and is well qualified to speak on this subject. His article will appear in the July number, and will answer many of the questions arising in the minds of railroad men relative to the heat treating process and to the handling of heat treated material in the repair shop. The second prize has been awarded to George Hutton and will appear in an early issue. Several other articles were received which will be published in whole or in part from time to time and which contain a number of valuable suggestions for the blacksmith foreman who may be called upon to handle a heat treating plant.

The Cleaning of Locomotives

We have never been able to see the logic in the argument that it is economical to let locomotives go without cleaning. In the first place, clean locomotives as well as clean cars help materially in advertising the road in the right way; then there is the standpoint of safety. There is no question that a locomotive can be much more thoroughly inspected if it is cleaned than if it is not, and the damage done by the breaking of a single part can very easily cause trouble that will cost in repairs enough to clean a good many locomotives a good many times. Only recently we had called to our attention a crack in a strap which, if the engine had been allowed to go without cleaning, as is the case on many roads, could not have failed to have resulted in a bad accident. In this case the engine was cleaned and it was due to this fact alone that the inspector was able to find the crack which, at the point where it was visible, was extremely small. It is surprising that the oil-and-water method of cleaning which has been so successful on the Lackawanna has not had a more extended application on other roads. The process of cleaning by this method is extremely simple, the cost is small and the appearance of the engines on that road is a plain indication of the results which it gives.

Locomotive Repair Facilities and Costs

It was recently stated by a mechanical department officer of a large road that while his road spent relatively a very large amount on locomotive repairs, the power was still not in as good condition as on some roads where the expenditure per locomotive-mile was lower. This officer did not understand why this should be so but he admitted that the shop and enginehouse facilities of his road were not as good as they ought to be. The saving that can be effected in the cost of locomotive repairs by adequate and up-to-date shop and enginehouse equipment is ample justification for the expenditure for such improvements. Consider, for example, two roads, one with a locomotive cost of 8 cents per locomotive-mile and the other one a cost of 15 cents. There must be some good reason why the road with the lower cost can obtain such a figure, it being assumed, of course, that the power is kept in good condition by an expenditure at this rate. It should be apparent without any extended argument that the difference between 8 cents and 15 cents per locomotive-mile when applied to the considerable total to which locomotive mileage climbs during a year of ordinary business, will constitute a percentage of the operating expenses which, if it appears in the form of a reduction, will prove ample justification for the money which has been expended in shop and terminal improvements.

Convention Papers and Discussion

It seems as if some improvement could be made as regards the amount of time taken up at conventions by the reading of papers. If the papers were sent out a sufficient length of time before the time of meeting there is no reason why every member should not familiarize himself with their contents so that all that should be necessary at the convention by the author or the committee chairmen is a few remarks emphasizing the more important parts of the paper. This would lengthen the time for discussion, and if the papers were properly gone into beforehand instead of being glanced through as the chairmen read them, the members would be much more likely to find in them points which they would feel competent to discuss. A good many of our mechanical conventions are given over to a large extent, and we feel to too great an extent, to the reading of papers which have been already printed, and, unless there has been some unusual delay, have been in the hands of the members for some time before they arrive at the convention. Under such circumstances it is the fault of the members themselves if they are not familiar with the contents of the papers and it does not seem right that the amount of time that is now commonly given to the reading of papers should be taken from the time of the convention when it could be used to much better advantage either in a discussion by the members or in some other way.

Dealing With Government Inspectors

Some railway mechanical men are severe in their criticism of the methods pursued by the boiler and machinery inspectors of the Interstate Commerce Commission. Doubtless, some of this criticism is justified but at the same time we believe that some of the railway officers are too prone to look for faults in the inspectors. Whatever the attitude taken by the individual members of the inspection staff, it is well known that those in charge of the inspection work have no wish other than to deal fairly with the railways in every way, meeting them half way or more than half way wherever it is possible. It is easy to understand how a foreman or master mechanic can have his

work considerably upset and his temper severely strained by the action of an inspector, but on the other hand we have known cases where the inspectors were antagonized from the first and would have been justified in taking even more severe measures than they ultimately did take. We do not believe that any inspector unless he be of an unfair mind, wishes to hold a locomotive out of service if it can be avoided in any way possible without violating the law; nor do we believe that the chief inspector desires to retain on his staff any man who is not disposed to give the railways a fair show. But a good deal of the unfairness of mind and attitude is on the side of the railway men. It requires a little diplomacy and a good deal of common courtesy on both sides but whether or not the railway men originally disliked the idea of having the inspectors around they may as well make up their minds now that inspection has come to stay and that it will be much easier to make matters run along smoothly if the inspectors are on their side, at least to the extent of knowing that they will do the right thing, than it would be to have them against them.

Welding Tubes in the Back Tube Sheet

When the practice of welding tubes in the back tube sheet was introduced about five years ago it promised much in simplifying boiler maintenance in the roundhouse. Under some conditions the practice has been very successful not only in increasing the life of the tubes but in reducing the cost of maintenance. The discussion of the report on electric welding at the convention of the Master Boiler Makers' Association brought out very clearly, however, that while electric welding of tubes has been successful in good water districts, it has been very much less successful in bad water districts. In all cases where bad water is used the tubes eventually leak in spite of the welds, and when leaking begins to take place, working the leaky tubes soon loosens the welds on those adjacent until conditions are no better than they would have been if the welds had not been made.

It is probably possible to make welds in the back tube sheet that will hold the tubes even under the most severe conditions but this would result in undue damage to the sheet when removing the tubes. The practice followed by one of the southern roads is worthy of attention in this connection. The tubes of engines running in bad water districts are not welded when applied, but are set in the usual manner. After the engine has been in service and when trouble from leaking begins they are welded in. They will then run for sometime longer before requiring constant attention. The result is a considerable saving in the amount of roundhouse work required to keep the engines in service, although the life of the tubes themselves is not increased.

Air Brake Association Convention

Those attending the convention of the Air Brake Association, held in Atlanta, Ga., last month, must have come away with two thoughts uppermost in their minds. The first relates to the problem of a proper foundation brake gear to be used on the improved heavy passenger equipment in service today; and the second, the necessity of giving much more attention to the proper maintenance of the air brake equipment, especially on freight cars, than has been the custom in the past. From the papers and discussion it was shown that considerable difficulty is being experienced in handling long passenger trains without injury to the equipment, let alone without inconvenience to the passengers. One prominent air brake inspector was heard to remark that break-in-twos in some of the best passenger trains on his road were becoming altogether too common. This trouble is caused by unequal brake cylinder piston travel on the different cars in the train due to inefficient foundation gear. To obviate such conditions it was believed that the clasp type of brake was a necessity.

The need of better air brake maintenance was made plain by the investigations mentioned in Mr. Purcell's paper on "Maintenance of Freight Brakes." Train line leakage not only means poor air brake performance, but in many cases limits the length of trains. Brake cylinder leakage is another source of a great deal of annoyance and considerable trouble; it causes unequal braking of the cars resulting in break-in-twos. Both the repairs to the air equipment and the train line leakage can be controlled by proper supervision and education of the air brake mechanics. This has been proved by several roads which control their train line leakage to below five pounds per minute.

The paper on "Air Brake Apprentices" was of special interest and will be found of considerable value, for it is here that the railroads are deficient. The work of the air brake repairman affects all the departments of the railroad. It is the results of his work that carry the trains over the lines with despatch and without damage. He should be carefully educated and instructed in his work. Air brake work is not for any Tom, Dick and Harry that happens along; it is a real man's job and requires experience and care.

Storekeepers' Association Convention

The recent convention of the Railway Storekeepers' Association at Detroit was well attended and the members in presenting their remarks seemed to know what they had to say and went about saying it without any undue delay. Undoubtedly the proceedings were materially assisted by President Stuart, who insisted on everything being done on time. There is room for improvement at all the conventions in the matter of adhering to the schedule and all could well take a leaf from the book of the Storekeepers' Association in this regard.

In his presidential address Mr. Stuart laid special stress on several important points, among which may be mentioned that of storekeepers familiarizing themselves more with the conditions and requirements affecting material in the various departments. There is a great deal of time lost and material delayed because of differences of opinion between the store department and whatever other department may be concerned. If the storekeeper will get in touch with what is going on in the various departments and learn so far as it possible how material is used and how much of it is used at various times, he will make himself a much better storekeeper and a much better man for his railway. Undoubtedly, as Mr. Stuart suggests, this adds to the breadth and responsibilities of the storekeeper's position, but it also tends to make of him a better all round railroad man, and what the railroads of this country need are railroad men and not merely department men.

Several papers were presented at this meeting on the handling of company material and the subject was considered of such importance that it was decided to have a committee to prepare a report for presentation at the next convention. The most important point brought out in all of these papers was in connection with the prompt release of cars which are loaded with company material in order to get them back into revenue service as quickly as possible. This is something that all storekeepers and in fact all railway officers should keep constantly in mind. Cars constitute a large part of the means of bringing in the company's earnings and every one that is kept in non-revenue service when it might be in revenue service is reducing the company's possible earnings. There is too much tendency on the part of the stores and mechanical department officers, at small points in particular, to consider a car more or less as of no great importance and consequently material is frequently left in the cars when it should be unloaded and the car released. Another

point that is worthy of attention in connection with the conservation of cars is the consolidation in one car of as many shipments as possible for outside points. It is a very common occurrence to find a number of cars moving in the same direction, and all with only partial loads in them. It is quite possible in many cases to make one car do the work of two or three.

Railway Fuel Association Convention

The importance of the International Railway Fuel Association to the railroads of this country and to railway men who are directly interested in the handling of fuel is increasing year by year. Of the subjects considered at the eighth annual convention, held in Chicago last month, that of powdered coal will be found of greatest interest to the mechanical department officers. The paper, which outlined the progress in the use of this grade of coal, was supplemented by a most interesting discussion. A large number of the members of the association who have ridden the Chicago & North Western locomotive, which was equipped during the past year with powdered coal burning apparatus, could not speak too highly of the performance of this engine in service. In addition to this the remarks of C. W. Corning, of the North Western, who has been with the locomotive constantly since the powdered fuel apparatus was applied, gave considerable additional information as to the merits of powdered coal in locomotive service.

Taking the discussion of the fuel problem as a whole, a thought of pre-eminent importance and one which appeared in almost every subject discussed, was that of the necessity of proper co-operation by the transportation and general operating officers in order to make a successful effort to save fuel. There is hardly a man in a railroad's employ who cannot contribute his mite toward fuel economy. While the engine crew are the ones who finally consume the fuel, it is necessary that they be assisted by having properly maintained equipment to operate, by being delayed on the road as little as possible, and by having the road conditions suitable for a good fuel performance. They should be properly trained and given every opportunity to know how they may best get the most out of a ton of coal. The importance of carefully selecting the proper grade of men for firemen was specially emphasized.

In the purchase and inspection of coal there is much that can be done to provide fuel that will prove the most economical to use. Chemical analysis and the price alone are not sufficient to determine what coal should be used. Careful service tests, supplemented by these two factors, should be the criterion on which to base the purchase of coal. The fuel bill for American railroads takes seven cents out of every dollar earned by the railroad companies. It is, therefore, an important factor, and is deserving of far greater attention than is at present given to it by some roads. The results obtained on the Chicago Great Western, as mentioned by S. M. Felton, president of that road, in his address before the association, show what can be done by giving this problem proper attention.

Painting of Steel Freight Cars

The condition of many of the steel freight cars in general service is so bad, due to the lack of paint, that we feel that it would be well to call the attention of mechanical department men to some of the statements that have been made by experienced car men as the result of careful experiments with cars painted in various ways. There has been a great deal of discussion as to whether or not it pays to keep steel coal and ore cars well painted but, as pointed out by M. K. Barnum, superintendent of motive power of the Baltimore & Ohio, in his article on the life and maintenance of steel cars, published in the *Railway Mechanical Engineer* for March, 1916, many of the higher officers who are responsible for the entire cost of operation seem to have come to the conclusion that it does not pay to paint them except when they receive new sheets or the letters and numbers need to be brightened up so that their ownership and identity can be distinguished. It would almost seem that any road would have sufficient pride in the appearance of its equipment to avoid the unsightly splashes that are daubed on many steel hopper and gondola cars in order to make a background in the general field of rust on which the letters can be placed.

It is not out of place to quote again from the report of the committee of the Master Car Builders' Association on this subject, presented at the 1908 convention, and to urge railway officers to give this matter of painting more energetic attention: "We cannot be too emphatic as to the necessity of taking the proper care of the exterior, and regret that we are not able to give the interior the same care. The painting of the inside of steel cars has been thought by some to be beneficial, but your committee can see no lasting results in this, and do not recommend it, but are of the opinion that coating the interior of the cars about once every six months with black oil would act as a preservative." As to the economy of painting steel cars Mr. Barnum says definitely in his conclusions that it will pay to keep steel cars well painted on account of preserving their strength, improving their appearance and extending their life, and a glance at some of the illustrations in his article should convince the most skeptical of the advisability of the proper protection of such cars.

Again in a comprehensive paper on the life of a steel freight car, read before the Pittsburgh Railway Club, and abstracted in the *Railway Mechanical Engineer* for January, 1916, S. Lynn, master car builder of the Pittsburgh & Lake Erie, one of the pioneer roads in the use of the steel car, says that if a steel car is given reasonable treatment and repairs are made when they are needed and *if the car is repainted when the steel becomes exposed to the weather*, the renewing of some of the parts will not become necessary for a longer period than is now the case. With what Mr. Barnum brings out in his article this testimony from such a road as the Pittsburgh & Lake Erie should provide ample evidence that proper painting of steel cars is not only desirable, but is essential, if the maximum life and earning capacity is to be obtained from these cars.

NEW BOOKS

Principles of Locomotive Operation and Train Control.—By Arthur J. Wood, M.E., assistant professor in charge of railroad mechanical engineering, Pennsylvania State College. Bound in cloth. 264 pages, 6 in. by 9 in. Illustrated. Published by the McGraw-Hill Book Company, Inc., 239 West 39th street, New York.

The absence of a text book presenting the recent developments in locomotive performance and including a study of air brakes led the author to prepare this work, which is intended as an elementary treatise for use in technical schools. At the same time the engineer may review in it the theories on which are based certain problems in design and construction. The author has endeavored to present the principles, beyond which lies the field for extended study. The book takes up tractive effort, the acceleration of trains and train resistance and there is a chapter devoted to new graphical methods applied to locomotive performance as well as one on dynamometer car tests and tonnage rating. Another chapter is devoted to air brakes while considerable space is also devoted to combustion and fuel economy; the formation and action of steam; theory and practice as regards superheated steam; locomotive ratios; testing, and counterbalancing. Chapters are also given to the electrification of steam railways, and materials of construction, while an appendix contains a number of valuable tables.

COMMUNICATIONS

LEAKAGE OF HORIZONTAL SHEATHING

HAMILTON, Canada.

TO THE EDITOR:

Regarding the leakage of outside steel frame, horizontally sheathed box cars, referred to in an editorial in the *Railway Mechanical Engineer* for March, 1916, if the question of water passing through the tongue and groove joint, apparently by some sort of capillary action, is a vital one in this design, would not a joint similar to that shown in the sketch minimize, if not entirely overcome this action?

A. E. HEFFELFINGER,
Chief Draftsman, National Steel Car Company, Limited.

TOBESURA WENO ON LOCOMOTIVE INSPECTION

(With apologies to Wallace Irwin)

CHICAGO, Ill.

Dear editor:

I have now become U. S. Federal I. C. C. detector. My job are to catch slick mms. and dope eater formen who defy Safety First and members of Honorable brotherhood.

I have assume great pleasure in presenting form 5 although some time it appear to create extreme disgust to mms. who affirm it are disagreeable and impudent interference with states rights and constitutional perogative of RR. corporation.

"I Dispute and Flash Scale and Caliper"

On large railroad I have just experience peculiar situation. I detect switchlocomotive with wheel rubbing on staybolt side sheet. I immediately call out forman and demand full explanation, assuming it are entirely necessary to douse fire to prevent disagreeable explosion. Foreman summon boiler man who reply that huge mistake been made on this engine. I inquire to know and he relate that she just complete new coal box in rear shop and on account bonehead bull by active foreman ¾ inch sheet installed by error. So soon as one sixty-fourth worn off by encroaching driver wheel, engine are to go to shop for new sheet of proper section. I agree and call attention to sand pipe not hitting middle of track. Foreman say it are correct so I dispute and flash scale and caliper. It follow as I say and sand distribute on track one thirty-second inches from center. I order repair made soon and when foreman disavow intention to defraud, I rescind Form 5.

Yours truly,

TOBESURA WENO.

A CORRECTION

CHICAGO, Ill.

TO THE EDITOR:

My attention has been called to a paragraph under the heading, "Supply Trade Notes," on page 272 of the *Railway Mechanical Engineer* for May, 1916.

It is there stated that the types of arch which the Universal Arch Company (formerly the National Arch Company) has placed upon the market "have been passed upon and accepted" by this association. In view of the wide circulation of your paper, I cannot allow this unauthorized statement to pass without correction, lest our members be misled. With one exception, this association has held that the arches, so far as known to us, offered by the Universal company infringe prior patents and can only be used, if at all, under bond.

GEORGE S. PAYSON,
General Counsel, Western Railroad Association.

APPRENTICESHIP IN THE DRAWING ROOM

OMAHA, Neb.

TO THE EDITOR:

It seems to be the practice on our road to let a boy start as a sort of a messenger for the drawing room and filing clerk as well, and then work into the drafting room. In this way he gets to see the different phases of the drafting business and may learn to read blue prints and incidentally to do some drafting before he takes up the work seriously.

Occasionally some little job will come up which does not require much experience, and it is given to the young hand to do. Gradually he is intrusted with more complicated work, and as soon as there is an opening on the table he is generally able to do fair work.

The greatest aid which I received while working up to my present position was the interest which was shown by the other draftsmen, who, when they could, explained drawings and the methods used by the draftsmen.

Another thing which always helped was that whenever any package or message was to go to the shops *rush*, we boys were the ones to take it. In this way, by keeping our eyes open, we could see how things were done and what could be done with iron, steel, etc. The thought that if we did keep our eyes open and learn things we would have a chance to become draftsmen was a spur and inspiration.

WILL C. MOONEY, JR.,
Draftsman, Union Pacific.

THE MECHANICAL DEPARTMENT CLERK

RAILROADVILLE, U. S. A.

TO THE EDITOR:

I heartily agree with the writer of the letter "The Mechanical Department Clerk," in your April number, having been a mechanical department clerk for 17 years and still being on the "blind alley job."

We are requested not to join any labor organization and personally, I feel that the request should be recognized by any clerk in this department, due to the fact that we come in contact with and have the handling of considerable important correspondence and details.

The highest point which a strictly mechanical department clerk can ever reach would be that of chief clerk to the superintendent of motive power. This would not happen to one in a thousand of us. I have clerks of my acquaintance who have never been advanced in position or salary, other than general increases which were given by the company of their own initiative. This is not so much the fault of the clerks as of opportunities which present themselves. Even the stores department would be a better place for a young man to enter as clerk. I know of storekeepers and superintendents of stores who have advanced from clerkships. Speaking of transportation department, I know of cases where men started in as clerks and advanced to the position of trainmaster and division superintendent.

I feel, along with A. C. Clerk, that the clerks in the mechanical department are not given proper consideration. We have full office details to look after and keep straight and this is no easy matter with the Interstate Commerce Commission and the various state commission rulings of the present day. Added to this, the factory inspection laws and requirements which affect some of our states, and the life of a clerk in the mechanical department of any railroad is anything but a bed of roses.

ONE OF THEM.

Fuel Association Conve

Papers on Powdered Fuel, Locomotive Maintenance, Fuel Purchase, Economy

Banquet of the International Railway Fuel Association

THE eighth annual convention of the International Railway Fuel Association was held in the Hotel Sherman, Chicago, May 15 to 18, D. C. Buell, Union Pacific, presiding. The convention was opened with prayer by Rev. Joseph A. Milburn.

PRESIDENT'S ADDRESS

Mr. Buell said in part: A survey of activities along fuel lines during the past year discloses several noticeable achievements, among which are the development of fuel economy devices, the excellent results obtained by a number of roads in the economical use of fuel and the completion and publication of the Report of the Chicago Association of Commerce Committee on Smoke Abatement and Electrification of Railway Terminals in which it was shown that the steam locomotive was a minor offender among the list of smoke producers. Among the important things yet to be accomplished in order to further improve the fuel service of our railroads may be mentioned:

First: The perfection and adoption of devices or schemes whereby an accurate check can be made on the amount of coal delivered to a locomotive and used during a trip.

Second: The working out of a practical plan for simple, accurate daily reports showing the economy or lack of economy with which fuel is being used, so that prompt action can be taken by those responsible for its use.

Third: The development and adoption of C O_2 recorders for use on locomotives.

Fourth: A reduction in the amount of fuel consumed by locomotives while at terminals. The possibility of running locomotives over more than one division may be worthy of careful reconsideration.

Fifth: A more careful review of the use of fuel for other than locomotive purposes. Approximately one-twelfth of a railroad's fuel bill is for coal used in this way.

Sixth: The education of new firemen before they are placed in regular service.

In connection with the latter item it is suggested that a school for new firemen be established at some central point on each system, where applicants can be instructed concerning the principles underlying practical locomotive firing.

There are two fundamental principles in connection with the present method of fuel handling that I desire to call particular attention to today. The first is the necessity for a more complete and thorough understanding of the importance of fuel matters by operating officials. The responsibility for fuel economy has too long been considered purely a mechanical department matter.

The second is the necessity for a more careful consideration being given to the dollar-and-cents value of things. It is my firm belief that railroad men must educate themselves as to the cost of material, supplies and operation more fully than in the past in order that they may more properly analyze conditions and thus be better fitted to apply their best efforts to those matters wherein the largest and most practical savings can be effected.

ADDRESS BY MR. FELTON

S. M. Felton, president, Chicago Great Western, talked on the "Railroad Fuel Problem, Past and Present." He described the system followed by the Pennsylvania Railroad on its Western lines during the Seventies. At that time that road charged each engine crew with the coal placed on the tender and a performance sheet was made up each month. In referring to the present practice he described the system followed on the Chicago Great Western, saying, in part:

In 1909 the line was equipped with the old-fashioned chutes, coal being unloaded by hand from gondolas and box cars at a cost of about 10c. per ton. In order to carry out the program decided upon, the old stations, which were pretty well along in years, were torn down and replaced by modern mechanical stations of the conveyor or balanced bucket type. Instead of having a number of small pockets the stations were designed with one large bin, which was mounted on or suspended from specially designed scales, the scale beam being placed on the track level where the inspector in charge of the coaling station could weigh the coal conveniently. By means of a registering device, duplicate tickets are printed showing the actual amount of coal taken at any time from the bin; one ticket is handed to the engineer and the other retained by the man in charge of the coaling station. The company provides self-clearing cars designed to handle the coal in the most economical manner, and keeps these cars in company coal trade. This makes it possible to handle coal at these stations at a cost ranging from 2 to 3 cents per ton, depending upon the tonnage handled; the cost includes maintenance.

When the contracts were made the actual analyses of the coal and the Btu's were embodied therein, and, in order to see that they were observed, samples of the coal as received were taken every two weeks and analyzed; in addition, a coal inspector was placed at the mine.

It was determined that it would be more economical to

use coal from one mine for each division, rather than have different mines supply the same division. After the contract is made, the superintendent has entire charge of its execution; the inspector at the mine reports directly to him; he has charge of the coaling stations, is responsible for the weighing, and is furnished with the analyses of the coal. The best possible supervision and most economical results are obtained, because of this concentration of authority.

The actual weight of coal in the tender of a locomotive is reported to the chief despatcher before the train starts, coal taken at intermediate coaling stations on the run is reported by wire, and upon arrival at terminal the coal on the tender is leveled off by a man assigned to that duty; the amount determined by means of measuring strips on the inside of the tender is likewise reported to the chief despatcher, who is then able to figure the exact amount of coal consumed on the run. The chief dispatcher gets the trainload when the train leaves terminal and the conductor reports to him any changes en route, so he is able to determine the gross ton miles handled by the engine during the trip. As a result of careful investigation, allowances are determined for the different engines and different classes of service, and if the engine has consumed more than the assigned amount of fuel the engineer is immediately interviewed in order to determine the cause of the trouble; it may be the fault of the engine crew, it may be the fault of the locomotive, but whatever the cause it is at once investigated and a remedy applied, so that a check is made daily instead of waiting, as used to be the custom, until the end of the month. The knowledge the engine crews have that the coal is actually weighed is worth many times what it costs to do the weighing.

On the eastern division, in passenger service, in 1915, compared with 1911, when the system was first put in force, the train mileage increased 1.5 per cent, being very nearly the same; the tons of coal consumed decreased 28 per cent, the cost decreased $25,851, or 28 per cent, and the pounds of coal consumed per passenger car mile decreased 31.7 per cent.

In freight service between 1911 and 1915, the trainload increased from 505 to 790 tons, or 56 per cent; the gross ton miles increased but 1 per cent, the tons of coal consumed decreased 27 per cent, the cost decreased $94,671, or 27 per cent; the tons of coal consumed per 100 gross tons moved one mile decreased 28 per cent, the price per ton having remained practically the same.

It was customary in days gone by to provide switching power in many cases from wornout road engines. But more recently a series of tests has demonstrated that the ordinary road engine does not make a desirable switcher and is anything but economical in fuel consumption, so engines specially designed for switching service, superheated and with brick arches and all the latest devices for the prevention of smoke have been adopted.

The use of powdered coal, which you are now so carefully studying, will undoubtedly give the most satisfactory results that can be looked for outside of the use of oil, and I look forward to the work you are doing in that direction with the greatest possible interest. You certainly should, and no doubt will, be encouraged in this work to the greatest possible extent by your executive officers.

In conclusion, the lesson to be drawn from this talk is:

First—Check-weigh and analyze coal at frequent intervals, as received from the mines.

Second—Weigh all coal to individual locomotives; keep records of the coal consumed, not only by locomotives, but by engine crews as well.

Third—Check the individual performance of locomotives and crews against the actual gross tons handled per freight train mile; per car mile in the case of passenger trains, and per hour worked by yard engines.

Fourth—The responsibility for the coal from the time it is mined to its final consumption should be fixed upon the division superintendent, so there may be no conflict of authority.

Fifth—In the purchase of new locomotives, specify superheaters and brick arches of approved form; also equip old engines where age and capacity justify the expenditure.

D. C. Buell, President,
International Railway Fuel Assn.

EFFICIENCY OF RAILROAD OPERATION

BY SAMUEL O. DUNN
Editor of the Railway Age Gazette

It is the irony of fate that the managements of the railways of the United States should have been subjected to criticism for alleged inefficiency at the very time when they have been giving the most splendid demonstration of efficiency in the history of transportation. It is not exaggerating, but speaking the words of truth and soberness, to say that the courage and efficiency displayed by their managements, in meeting and triumphing over the unfavorable conditions with which they have had to deal during the last ten years, have never been exceeded in industrial history.

Many abuses have existed and many offenses have been committed on our railways; but we should begin to recognize and emphasize the fact that the shortcomings of their managements have been far more than compensated for by their constructive achievements. Consider briefly the circumstances in which their officers have had to do their work during the last ten years. In August, 1906, the Hepburn act went into effect, giving the Interstate Commerce Commission increased authority over rate-making and accounting and over some features of operation. Maximum freight rate laws, 2-cent fare laws, acts prescribing the number of hours the employees might be kept at work, the number of them there should be in train crews, etc., were poured forth in all parts of the country. There was a perfect cloudburst of regulatory laws and orders. There was one great and successful movement after another by railway employees for increases in their wages. There were demands for new and improved facilities—for steel cars, the elimination of grade crossings, the installation of block signals, and so on—which caused heavy additions to the investment demanding that a return be paid on it.

Let us see what was the effect of certain of the more important changes which occurred during this period on earnings and expenses. The average freight rate per ton

per mile was reduced from 7.48 mills in 1906 to 7.33 mills in 1914, and the average passenger rate from 2.003 cents to 1.982. That cost the railways $50,800,000 a year; and it includes nothing for the reduction of express and mail rates.

The taxes the roads had to pay were increased from 3.2 per cent to 4.6 per cent of their total earnings. This increase in the *rate* of taxation made the total taxes paid in the year 1914, $42,650,000 greater than they would have been if this increase in the rate of taxation had not occurred. The average compensation of a railway employee in 1914 was $218 greater than in 1906, which makes a total of $369,600,000 more than it would have been on the basis of the average wages paid in 1906. These reductions in rates and increases in taxes and wages between 1906 and 1914 made a total increase in the annual burden, direct and indirect, that the managements had to carry of $462,902,000. In 1906 it took 69 cents out of every dollar earned to pay operating expenses and taxes. In 1914 it took 77 cents out of every dollar earned to pay operating expenses and taxes. If none of these changes in rates, taxes and wages had occurred, and the roads had been managed and operated otherwise just as they were, their net operating income in 1914 would have been $1,168,900,000 instead of only $706,000,000, and it would have required only 61 cents out of each dollar earned to pay expenses and taxes, as compared with 69 cents, the outlay per dollar of earnings for operating expenses and taxes in 1906, and 77 cents, the actual outlay for these purposes in 1914.

These data are a striking vindication of the efficiency of the management of our railways. They show clearly that the roads were constantly being operated more and more economically, but that much faster than they could save money it was being taken from them. They also show that it was the rate-regulating authorities, the tax gatherers and the employees who were taking it. Let us hope that the time will come when those who serve the railways, and through them the public, so well as do the International Railway Fuel Association and its members, will have their work better appreciated by the public, and will not see the results of it constantly swept away chiefly to benefit classes of persons connected with the railways who constantly strive to prevent increases in the efficiency of operation or other classes of persons who are not connected with the roads at all.

Various other steam railways, among which may be mentioned the Atchison, Topeka & Santa Fe, Grand Trunk, Southern Pacific, Kansas City Southern, Chicago Junction, the Delaware & Hudson has just put into freight service a new powdered fuel burning Consolidation locomotive, probably the largest of this type in the world. The Delaware & Hudson is also installing a complete fuel drying, pulverizing, storage and disbursing plant, and is equipping the stationary boilers at Olyphant, Pa., for burning the waste tailings from anthracite culm banks. The Missouri, Kansas & Texas is installing a complete pulverized fuel preparing plant at Parsons, Kas., and applying equipment or burning pulverized coal and lignite in its stationary boilers and locomotives.

The usual methods for burning pulverized fuel necessitate the use of steam, air or mechanical contrivances for projecting the fuel, or a mixture of fuel and air, into the furnace. When applied to steam generators this process has resulted in failure due to the severe effect of concentrated heat on the firebrick and firebox. The more recent process, as applied to the Chicago & North Western and other steam locomotives, provides for a combustible mixture of fuel and air being automatically induced or drawn into the firebox by means of the front end draft, and its perfect combustion in suspension without any concentration of heat, due to the fact that the combustion flameway and the products of combustion are at all times being drawn toward an opening and thereby avoid any impinging action. Furthermore, this process is divided into three stages, *i. e.*, conveying and comingling of fuel and air, gasifying of combustible mixture, and perfecting of the combustion in the final high temperature heat zone, all of which insures completion of the combustion process.

From observations taken with fuels of different kinds and degrees of moisture and fineness, in every case the smokebox gas analyses will average between 13 and 14 per cent of CO_2 when coal is fired at the relatively low rate of about 3,000 lbs. per hour, and is increased to 15 and 16 per cent of CO_2 as the rate of combustion increases, so that there is no falling off in the efficiency, as obtains when coarse coal is fired on grates. At the same time the smokebox temperatures are maintained between 425 deg. and 500 deg. F. Summing up the results that are being obtained from the use of powdered coal in locomotive service, they may be stated as:

First—Smokeless, sparkless and cinderless operation.

Second—Maintenance of maximum boiler pressure within a uniform average variation of three pounds without popping.

Third—An increase of from 7½ to 15 per cent in boiler efficiency as compared with burning lump coal on grates.

Contents	Illinois Bituminous Unwashed Screenings		Kentucky Bituminous Screenings	North Dakota Lignite	Pennsylvania Bituminous Run of Mine					Pennsylvania Anthracite Waste Tailings from Culm Banks			Pennsylvania Bituminous Run of Mine		
Moisture .....(%)	From 3.18 to 15.36		1.9 to 2.8	1.8	0.72	0.95	0.51	0.88	0.67	Average 0.50			Average 0.50		
Volatile .....(%)	Average 34.0		36.0	47.25	62.51	59.80	59.17	63.05	65.16	Average 8.30			Average 33.0		
Fixed carbon .....(%)	Average 47.0		54.0	40.91	8.94	9.35	9.59	10.40	13.21	Average 72.09			Average 57.50		
Ash .....(%)	Average 10.0		8.0	9.32	28.75	30.85	31.25	25.67	21.63	Average (12 to 22), 16.50			Average 9.0		
Sulphur .....(%)	Average 1.70		0.79	0.72	2.49	2.30	2.21	1.64	1.51	Average (0.66 to 1.97), 1.00			Average 2.00		
B. T. U.....	From 10,720 to 12,400		13,964	10,960	14,096	13,773	13,804	13,912	13,671	Average 12,000			Average 13,750		
Fineness:															
Through 100 mesh.(%)	From 90.7 to 99.69		93.0	98.0	From 88.0 to 96.5					98.7	100.0	99.68	98.1	100.00	98.46
Through 200 mesh.(%)	From 71.45 to 97.06		83.0	95.9	From 66.5 to 96.0					75.3	85.6	92.41	77.0	86.5	89.37

and Central Railway of Brazil, are now considering the use of pulverized fuel for locomotive service, the last named road having already decided to adopt it after an exhaustive three months' investigation made in the United States.

During the past year various fuels have been successfully burned in pulverized form in railway locomotive and stationary boilers performing regular service, and a list of some of these follows. The analyses are of the fuels when in pulverized form, ready for use.

POWDERED FUEL

Since the last meeting of this association the Chicago & North Western has equipped an Atlantic type locomotive for burning powdered fuel which is now operating in regular passenger train service between Chicago and Milwaukee and

Fourth—Saving of from 15 to 30 per cent in fuel of equivalent heat value fired.

Fifth—Enlarged exhaust nozzle area, resulting in greater drawbar pull and smoother working of locomotive.

Sixth—Elimination of ashpit delays, facilities and expense and reduction in time required for, and ease in firing up.

Seventh—Maintenance of a relatively high degree of superheated steam.

Eighth—No accumulation of cinders, soot or ashes in superheater or boiler flues, smokebox, or on superheater elements.

Ninth—No punishment or overheating of firebox, new or old sheets, seams, rivets, patch bolts, stay or flue beads.

Tenth—Elimination of arduous manual labor for building, cleaning and dumping fires.

Eleventh—Avoids expense and annoyance of providing various sizes and kinds of fuels.

Twelfth—Eliminates the necessity of front end and ash pan inspection and for special fuels, firing tools and appliances for building fires and for stoking and cleaning fires.

Thirteenth—Equal provision with engineer for fireman to observe signals and track, thus reducing liability of accident.

The committee is of the opinion that the effectiveness and utility of the use of fuel in pulverized form has been demonstrated from the past year's development, and that the progress in the use of this method of stoking and burning bituminous and anthracite coals and lignites for generating power, heat and light on railways will be quite marked from now on. The constantly increasing cost of railway fuel at the mine; the scarcity of fuel oil; the domestic and export demand for the larger sizes of coal; the prohibitive cost of briquetting the smaller sizes of coal and of lignite for railway use; the payment of labor on the run-of-mine basis for mining bituminous coals; and the necessity of eliminating smoke, sparks and cinders, will all tend toward the inauguration of this practical means and method for increasing the efficiency of steam boiler operation which today affords the greatest opportunity for improving locomotive and power plant costs and performance, and for changing public sentiment by smoke abatement.

The report was signed by: W. L. Robinson, chairman (B. & O.); H. T. Bentley (C. & N. W.); W. J. Bohan (N. P.); M. C. M. Hatch (D. L. & W.); H. B. Brown (I. C.); D. R. MacBain (N. Y. C.); A. G. Kinyon, (Pow. Coal Eng. & Equip. Co.); H. C. Oviatt (N. Y., N. H. & H.), and L. R. Pyle (M., St. P. & S. S. M.).

W. H. Averell, Vice-Pres.
International Ry. Fuel Assn.

J. G. Crawford, Sec.-Treas.
International Ry. Fuel Assn.

E. W. Pratt, Vice-Pres.
International Ry. Fuel Assn.

DISCUSSION

The theory of the burning of powdered coal was likened to that for the burning of fuel oil, that is to say, the coal being ground to such a fine state enters the firebox of the locomotive in the same condition as the atomized fuel oil. If it is properly mixed with air, it will be immediately and completely consumed. The coal, however, should be properly prepared. It is necessary to have thoroughly adequate machinery for drying and pulverizing it to the proper degree of fineness. The coal should not contain more than one per cent moisture and should be of such fineness that 95 per cent will pass through a 100 mesh screen and 85 per cent will pass through a 200 mesh screen. While this degree of perfection was not obtained with the coal used on the Chicago & North Western locomotive there was a marked decrease in coal consumption shown in comparative tests. Without the proper dryness and proper amount of air it was found that slag and honeycombing would occur.

It was stated that the cost of drying and pulverizing the coal would vary according to location and the amount of coal pulverized. One set of figures, given by H. G. Barnhurst, of the Fuller Engineering Company, for the Lehigh Valley district showed a variation of $1.00 per ton for a mill of 10-ton capacity to 29 cents for a mill of 250-ton capacity, these costs including the interest and depreciation of the entire plant.

Of the various coals mentioned in the report as being used it was stated that the Kentucky bituminous and the North Dakota lignite gave very good results. Trouble was experienced with the Illinois bituminous due to the high percentage of moisture. Tests with the powdered lignite were especially successful, and this has a direct bearing on the roads in the Northwest. It was stated that one ton of powdered lignite at $1.60 would give as good results as the same quantity of the eastern coals at $4 per ton hand fired. A mixture of anthracite and bituminous coal is being experimented with on the Delaware & Hudson pulverized coal locomotive. At the present time a mixture of 40 per cent anthracite and 60 per cent bituminous coal is being used successfully and it is believed possible by further experimentation to bring this to 80 per cent anthracite and 20 per cent bituminous. In stationary plants 100 per cent anthracite powdered coal can be used. It was also mentioned that due to the methods of mine operation at the present time the slack is obtained in larger quantities than ever before; this can be very advantageously used on powdered fuel installations.

Tests made on the Chicago & North Western showed that more than 30 per cent saving in the weight of coal consumed was obtained in the powdered coal superheater Atlantic type locomotive over a similar saturated steam locomotive hand fired and a saving of 15.92 per cent was shown over a similar superheated steam locomotive hand fired. The steaming capacity of the powdered coal locomotive was far greater, it being found necessary to replace the 3-in. safety valves with 4-in. safety valves to properly relieve the boiler. There was no difficulty in maintaining the full boiler pressure on the powdered coal engine and care must be taken, as in fuel oil locomotives, to avoid excessive popping. No difficulty was experienced in operating this engine in cold weather. With the application of the powdered fuel equipment the size of the exhaust nozzle was changed from 5 in. by 4½ in. to a round nozzle 5½ in. in diameter.

It was stated that no boiler repairs have been made that were attributable to the pulverized fuel installation. In the nine months the engine has been operating the tubes have been blown twice and the superheater unit ends remain clean. It has not been necessary to clean the smokebox during that

time. The arch tubes have been increased to 3½ in. in diameter to provide for the extreme heat of the firebox. It was found that the fire brick used in connection with the powdered coal equipment does not burn out nearly as rapidly as was first expected, due to the fact that there was no pronounced impinging action of the flame on the brick work.

The advantages mentioned for the use of the powdered fuel were the utilization of the cheaper grades of fuel, especially that now being absolutely wasted, a larger field for the use of lignite, less absolute fuel consumption, better utilization of the fuel, elimination of smoke, cinders and sparks, greater boiler capacity and greater safety in train operation due to the fireman being free to give closer observance to signals. This latter item was believed to be of great importance.

LOCOMOTIVE MAINTENANCE AND FUEL ECONOMY

By A. N. WILLSIE
Chairman, Fuel Economy Committee, Chicago, Burlington & Quincy

Every delay, every piece of careless or indifferent work to a locomotive on the part of road or shop or roundhouse men, every neglect of attention on parts of machinery wear, or boiler and flues allowed to become foul, all revert back to the coal pile. The boiler capacity and heating capacity should be great enough to more than fill the cylinder volume, as the engine cannot be 100 per cent efficient all the time on account of the varying condition of the fuel; the condition of the water; of the boiler and flues; inexperienced firemen, and men newly promoted to the position of engineer. Boiler repairs must not be neglected, as the boiler is the vital part of the engine. The heaviest drain of all the accessories on the boiler are the air compressors.

Many times from 10 to 15 per cent of the entire coal consumed on a trip is used to generate steam which is used by the compressors. Air compressors should be equipped with the proper kind of strainers to protect the air intake. Arrangements should be made so that it is possible to lubricate the air end properly. There should be no traps in the steam line between the supply valve and governor, or between the lubricator and the steam line leading to the compressors—yet how often this occurs! Another important factor is to see that the proper sizes of pipes and valves and governors are used for the different sizes of compressors.

The air compressor exhaust should be located so that the steam will not go directly up the stack, as when standing this creates a terrific draft on the fire, with same effect as a strong blower, resulting in a great waste of coal. I believe every engine should be equipped with a two-way valve, controlled from the cab, so that the pump exhaust can be turned into the tank, when so desired. Heating the water in tanks results in a saving of coal to the amount of one per cent for each eleven degrees of increased temperature.

It will surely pay well to cover the steam line to the air compressors' steam pipes with a good insulation; but better yet, put as much of the pipe as possible under the boiler lagging. According to Steam Power Plant Engineering, by G. F. Gebhart, Professor of Mechanical Engineering of Armour Institute:

"For most practical purposes the loss of heat from bare steam pipes or drums may be taken at 3 B.t.u. per square foot heating surface per hour per degree difference in temperature of steam inside and air outside."

From tests made by Dean Goss several years ago on a small engine with 61 per cent of the boiler covered, the loss due to radiation while standing was 18 lb. of coal per hour, temperature of the air being 80 degs. The loss at 28.3 m.p.h. was 37 lb. of coal per hour. On the same boiler with no covering the loss, standing, was 48 lb. of coal per hour. At 28.3 m.p.h. the loss was 100 lb. of coal per hour. This gives an idea of the importance of keeping the boilers well lagged, and also of getting them out with the least terminal delay.

There seems to be a variance of opinion as to the losses due to the accumulation of scale in boilers. Some of the best authorities give the losses about as shown in the following table:

LOSS OF HEATING POWER DUE TO SCALE
(Approximate)

Thickness of scale	1/64	1/32	1/16	⅛	3/16	¼	⅜	½	⅝	¾
Per cent loss of heating power	2	4	9	18	27	38	48	60	74	90

These figures are not considered absolutely accurate, as these losses are not found to occur in all boilers, because the whole of the boiler surface does not usually become covered; still the loss is always serious, apart from the stresses set up in the boiler plates.

I have been unable to obtain any reliable data as to the percentage of loss due to soot in flues on locomotives, but my opinion is that the amount of soot that will adhere to the inside of a flue will cause as much loss of heating power as 1/64-in. scale on the water side of flue, or 2 per cent, and any ash accumulating in the bottom of flues causes still a greater loss, according to the area covered. Prof. Ordway, in the Transactions of the American Society of Mechanical Engineers (Vol. 6, page 168), shows that there are only two materials that rank higher than soot as non-conductors of heat. The first is loose wool; the second is live goose feathers. Asbestos is thirteenth on the list.

A boiler should be washed regularly, using hot water with a pressure of about 100 lb. Begin early and keep at it, and do not allow accumulations of sludge. Nothing is gained by trying to get too many miles out of an engine between washings, as the boiler getting foul results in water being carried over into cylinders, ruining lubrication and packing; and the mud and scale in boilers reduce the absorption of heat.

Engines should be drafted and grated for the coal that is to be used, and the same grade of coal should be supplied as far as practicable. In this way the crews become familiar with the best way to handle the coal, and the engines will burn it more economically. The center of the nozzle must not only be plumb with the center of the stack, but it must be level, otherwise the exhaust steam will not properly fill the stack. In order that the nozzle and front end may perform their functions the flues must be kept clean and dry, and no leaks allowed in steam pipes, dry pipe connection or nozzle stand seat. When an engine begins to lag on steam, reducing or bridging the nozzle should be the last resort; the trouble is usually at some other place.

Flues should be cleaned every trip, especially on superheater engines. If the superheater flues are not free but little superheated steam will reach the cylinders.

Water losses should not be neglected. A total leak of but one pint per minute is 180 gallons per twenty-four hours. One hundred and eighty gallons per day is 65,700 gallons per year; this at 5 cents per 1,000 gallons represents a loss of $3,285 per engine per year. One pint per minute is a very small leak, taking into consideration the leaks around tank, tank hose and injector overflows, etc. Water is wasted by carelessness in filling tanks; they often overflow to the amount of 100 gallons or more.

All steam leaks must be avoided, such as those in valves in cab, injector throttles, blower valve, boiler checks, surface blow-off valves, valve to headlights and heater valves. On engines in freight service equipped with train heating apparatus the steam valve in cab is usually cracked a trifle to allow some circulation, to avoid the line freezing up; this soon cuts the seat; then it is impossible to close the valve tight. On engines in this class of service I would suggest that a small by-pass valve be used, so that circulation may

be possible with no injury to the main and reducing valves. The expense of grinding in the small valve will amount to nothing compared with the other valves.

All steam joints in front end should be tested every thirty days. Leaks in front ends of superheater engines can be so bad that no superheated steam reaches the cylinders, yet the engine may work along, doing nearly as well as a saturated engine. If such leaks occurred with a saturated engine there would be a complete engine failure. Simmering flues soon honeycomb the sheets, reduce the heating surface and waste coal. Honeycomb must be removed from all parts of the firebox. It is often allowed to remain on crown staybolt heads.

Grates must be kept in good condition, so that they will work freely, and there should be no unnecessary openings, such as broken fingers. If the grates work hard the fireman puts the job of shaking off as long as he can, resulting in heavy fires and waste of fuel. Grates should be shaken only when necessary, and not too hard. They should be shaken only when the engine is standing or drifting in order to avoid tearing holes in the fire.

Arch tubes should be used. This not only gives more heating surface, but makes it possible to get many more miles out of the arch brick. Arches supported on studs do not last nearly as long, and when one brick goes down, at least one more (the opposite) goes with it; then the trip is continued with an arch of improper dimensions, resulting in loss of fuel. The saving in coal by use of an arch is not all due to the arch itself, as by the use of an arch the fireman is compelled to do a better job of firing than he might possibly do were there no arch in the firebox. The maintaining of a good arch of the proper height reduces a great deal of the front end losses, which are greater than generally considered; these front end sparks contain 25 to 40 per cent carbon.

The decks of the engines must be kept tight; no opening should be allowed around the pin hole or shaker levers and other places. A loss of 200 lb. per trip through such openings is very conservative with the average fireman. The same applied to the decks of tanks; and the shovel plate should be smooth, with no seams or rivets. Tanks should be built so that coal will be kept within easy reach of the fireman. There should be guards to prevent coal working out of gangways. Usually the coal space is longer than it is wide; if so, the tail board should be higher, or shaped to conform to the crown of the pile of coal on tender. The manhole on tender should be as long as allowable, so that the water crane spout will fit. This saves delay, also saves water and time filling the tank.

The stacks should be covered while in the house, to save heat and save the flues, and the boiler will hold steam much longer. If an engine is kept in good condition it is not only possible for it to do better work, but it encourages the engineer and fireman to do better work. When they are able to handle the trains faster the conductors and brakemen naturally get into the game, also the despatcher, with the result that the crews are on the road less time, saving time and overtime, all of which saves coal, if the engine is not worked beyond the economical point.

DISCUSSION

Considerable stress was laid upon the necessity for maintaining the locomotive and the air brake equipment of the cars in proper condition. Applying the figure of $.00015, given by Mr. Willsie in his paper as the cost for fuel for air leaks per car mile, to the total revenue car mileage in the year 1914, it was found that over $3,000,000, or about 1.3 per cent of the total fuel bill, was spent in this way. It was also pointed out that by keeping the air leakage down it was possible to materially increase the length of trains, especially on the mountain grades.

While the effect of soot in tubes in locomotives was not definitely obtained, it was stated that in stationary practice it was found that the soot would collect cinders, forming gas pockets which insulate the heating surface of the tubes from the hot gases. In this connection it was stated that for every 20 deg. decrease in stack temperature there will be a saving of one per cent in fuel. The use of the pyrometer on superheater locomotives was strongly recommended as a device that would soon pay for itself due to the fact that the condition of a locomotive can be more accurately determined. Without the pyrometer it is difficult to determine whether the proper superheat is being obtained. The packing of the engine should be carefully maintained and the valves kept square. The proper maintenance of the arch and clean tubes have shown that savings of 10 to 15 per cent can be obtained.

FRONT ENDS, GRATES AND ASH PANS

Front End.—The taper stack seems to be the most generally accepted design. Many previous experiments have shown that this form is somewhat more efficient and also more "flexible" than the straight type.

The exhaust jet acts to move the gases by frictional contact, and by enfolding and entraining them. The whole surface of the jet, from the time it leaves the nozzle until it finally fills the stack, exerts this action on the gases, and hence it would seem logical to make the travel of the jet in the front end as long as possible. In other words, the highest stack with the lowest exhaust base should be the best combination. If a "basket" around the nozzle is not used (and there seems to have been some fault found with this design) the lowest limit of exhaust base will be that which allows sufficient gas area under the table plate, and no more.

The adjustable petticoat or draft pipe seems to be disappearing, and this is believed to be consistent. In place of the petticoat pipe the extended or drop stack is employed, with a generous flare at the bottom, and run as high above the nozzle as can be done and still clean the table plate. With this plan we do not believe that "over-draft" is necessary or desirable.

We wish to go on record as decrying the use of bridges or splits in exhaust nozzles. It is of course a fact that, if the over-all design is not right, a split may help to make an engine steam, but its use is at best merely introducing an evil to partly counteract another, which may, however, be basic. Any bridge or split increases cylinder back pressure, and hence is undesirable.

In general it may be said that: Taper stacks are desirable; the lowest possible exhaust base should be used; the adjustable petticoat pipe should be discarded; maximum netting area should be employed; bridges or splits should be avoided; "over-draft" should be eliminated, and the only adjustment (if any) to be made should be in the diaphragm apron.

Grates.—The grate is the mechanical supporter of combustion, just as oxygen is the chemical supporter, but nothing like a proportionate amount of study has been given to it. Material and design have generally been on a more or less haphazard basis, the iron used being whatever happened to come out of the cupola, and the design following general practice, which may or may not have had originally some good and consistent basis. There is no limit, from a combustion standpoint, to the air opening which could be permitted to advantage. We should endeavor to obtain as large an amount of air opening, evenly distributed through the grate bars, as can be done without mechanical loss of fuel. One road is experimenting with a grate of the non-interlocking, cross-rocking, finger type, in which an air opening of slightly better than 50 per cent is obtained. Besides improving combustion by reducing the restrictions imposed on the flow of air to the fire and distributing it more evenly

throughout the fuel bed, we may expect a reduction in clinkering.

The matter of interlocking versus non-interlocking fingers is one which is open to discussion. The interlocking type introduces features which may tend to cause unnecessary burning of grates, as the fingers are long, and it is a frequent occurrence for clinkers to catch between fingers of adjacent sections when they are rocked, either forcing them out of place or cocking them. This type gives, of course, a more pronounced "chopping" action on the fire than the non-interlocking, but with most coals if a consistent thickness of fire is carried and excessive hooking (tending to cause clinker) is not indulged in, the non-interlocking type offers advantages which are worthy of consideration.

Grate fingers in transverse cross-section should be approximately sections of a frustrum of a cone, with the base up. This shape gives better air inlet conditions than if fingers are rectangular in section, and also allows the grates to clear themselves to much better advantage, as the space between the fingers, through which ash and refuse must pass, is of constantly increasing area below the grate surface.

The material used in making grate bars should be cast iron of maximum strength commensurate with toughness, small shrinkage and high melting point. As a rule it is difficult to control with any degree of exactness the mixture from which grates are cast, as special heats are seldom run for this purpose, the ordinary practice being to use the general casting mixture. Some study has, however, been given this matter, and the committee would tentatively recommend the following analysis:

Silicon	1.20 per cent to 1.40 per cent
Phosphorus	not over .50 per cent
Manganese	.75 per cent to 1.00 per cent
Sulphur	trace to .10 per cent

Experiments with a mixture approximating the above have been made with good results, although they have not been carried far enough as yet to give any comparative figures.

Ash Pans.—The committee recommends the largest possible amount of air opening in the ash pan, with a minimum of one square foot of opening for each 7 sq. ft. of grate area, or a percentage of about 14, this holding for bituminous coal. For anthracite, 50 per cent of the above ratio may be used. Two locomotives, recently tested at Altoona, Pa., having identical boilers, but with, in one case, an ash pan air inlet area of 12.2 per cent of grate, and in the other of 11.1 per cent, a difference of 10 per cent, showed efficiencies throughout the entire range of fuel rates 4.5 per cent greater for the first than for the second.

Ash pan volume should be as large as consistent with the design of the locomotive, and not less than 1.25 cu. ft. for each square foot of grate area. In many cases, on large power, this will mean multi-hopper pans, but these are to be desired rather than to sacrifice necessary space for simplicity of design. A small pan will, under some conditions, seriously affect the steaming qualities of the boiler. A point in favor of multi-hopper pans is that in such a design it is possible to make all slope sheet angles greater than the angle of repose of ash. This again tends to keep air intakes free and to reduce burned grates, and also does away with the somewhat common practice of flushing the flat pan sheets by a stream of water, which is bound to have a bad effect on hot cast iron grates.

General.—The heat loss in the furnace offers a great field for investigation. We lose heat here, first, by sparks and cinders; second, by the escape, unconsumed, of certain CH_4 series hydro-carbons; third, by CO; fourth, by combustibles through the grates; and fifth, by radiation at the grate.

The most efficient furnace design can be reached by the use of large grate areas, by large combustion chambers, and by allowing the admission of plenty of air (there should not be less than 50 per cent excess) through grates and ash pans. The large grate area will reduce the rate of combustion at maximum boiler outputs and thus reduce spark losses (which are proportionate to fuel rate) and CO losses. The combustion chamber will shorten the tubes, will increase the heat absorbed by the firebox, will lower the gas temperature entering the tubes (and hence the front end temperature, which is a measure of efficiency) and will conduce to better mixing and burning of the elements of combustion. An excess of air, obtained without restriction, is a prime necessity for perfect combustion, and it is not believed that, within reason, it exerts a deleterious effect on firebox temperature and evaporation.

The velocity of the gases through the tubes has an important bearing on the capacity of evaporation of the tube heating surface. Other conditions being equal, the evaporation increases almost directly as the velocity of the gases increases, while the efficiency decreases but very little after the point of critical velocity has been reached.

At ordinary or low speeds the gases seem to flow in stream lines, and that portion of the gas nearest the metal becomes cool and tends to act as a sort of insulation against the hot gases flowing through the center. When the critical velocity is reached this stream flow is broken up by violent eddying, which tends to mix the hot and cool particles and increase the rate of heat transfer.

The report was signed by: M. C. M. Hatch, *Chairman*, (D. L. & W.); Ralph Bradley, (B. & M.); E. B. De Vilbiss, (Penn. Lines); W. F. M. Goss, (Univ. of Ill.); H. B. McFarland, (A., T. & S. F.), and J. P. Neff, (Am. Arch. Co.).

DISCUSSION

L. R. Pyle, of the Minneapolis, St. Paul & Sault Ste. Marie, called attention to the fact that some of the States are requiring a legal standard for the size of openings and size of wire for the front end netting, in order to reduce the liability of live sparks passing from the locomotive. He stated that the oblong mesh gave better results than the square mesh in that the cinders are broken up to a greater extent before leaving the front end, and that a greater opening was obtained with the attendant less resistance to the draft. Recent tests have shown a decrease of six per cent in the amount of steam used to do the same amount of work after the nozzle tip had been increased 5/8 in. in diameter, which was due to the reduction in back pressure in the cylinder. It was also stated that the relation of the height of the table plate to the top of the tip was of importance. The Santa Fe finds that by placing the table two inches below the tip the best results are obtained. The question of grate and ashpan opening was discussed to some extent, and particular stress was laid upon the necessity of having these openings as large as possible.

FUEL STATIONS

At the last meeting of the association, it was suggested that some reliable automatic means and devices might be cheaply installed, operated and maintained; not only on new plants being installed, but also to plants that are in operation; and also that certain devices might be developed to provide automatic and reliable record of the actual amount of coal issued by each plant to each locomotive and engineman. At that time, reference was made to a certain device for weighing and measuring coal, and since then the committee has endeavored to urge all manufacturers to complete their studies and plans, and we are submitting the results of the year's work.

DESIGN A

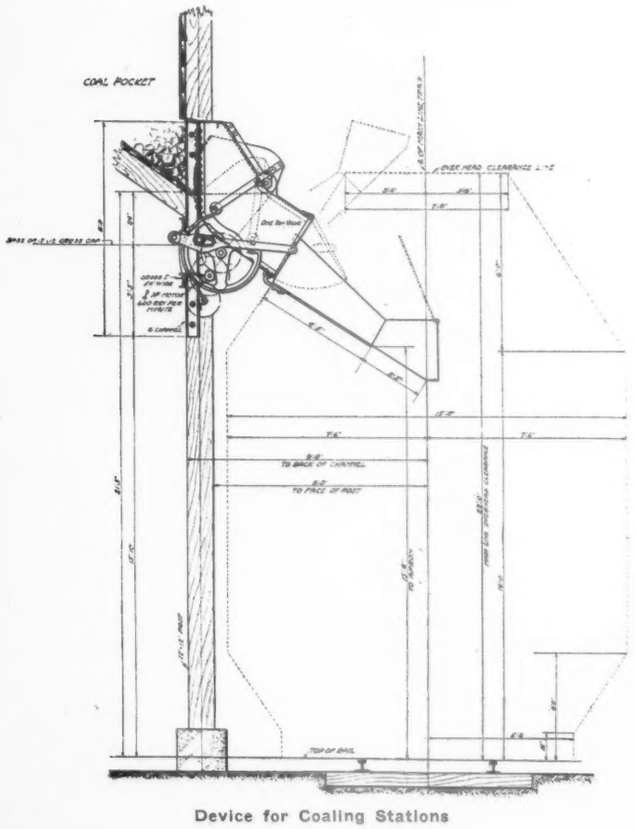
This measuring device consists of a square box holding a full ton of coal. At the back of the box is located a curved undercut gate to cut off the flow of coal between the coal pocket and the measuring device. The front of the box is closed by means of a gate hinged at the top; both openings

in the box, front and rear, are of ample size to allow the coal either to escape quickly or to flow into the box quickly, whether small or large coal is used. The two gates operate alternately—that is, when the back gate is open, allowing coal to flow from the pocket into the box, the front gate is closed, and *vice versa*. Both gates are positive in operation, and the device may be operated either by hand power, by electric motor, air, steam or other power. An apron is hinged to the bottom of the box at the front in such a manner that it may be swayed from side to side. This distributes the coal evenly over the tender without moving the locomotive.

The workable cycle of operation of the measuring device has been found to be four measures or tons per minute when operating by power. If operated by hand the number of measures per minute would be reduced.

The measuring device is provided with a revolution or cycle counter, registering one ton for each cycle of operation. Each fireman on the arrival of his locomotive at the coaling station records the number of tons shown on the counter. He then takes as many tons as he requires and records on his ticket the final number of tons as shown by the counter. The difference between the two records indicates the amount he has received. By this method each fireman's record is a check on the one preceding and the one following his locomotive.

This measuring device has been designed with the object



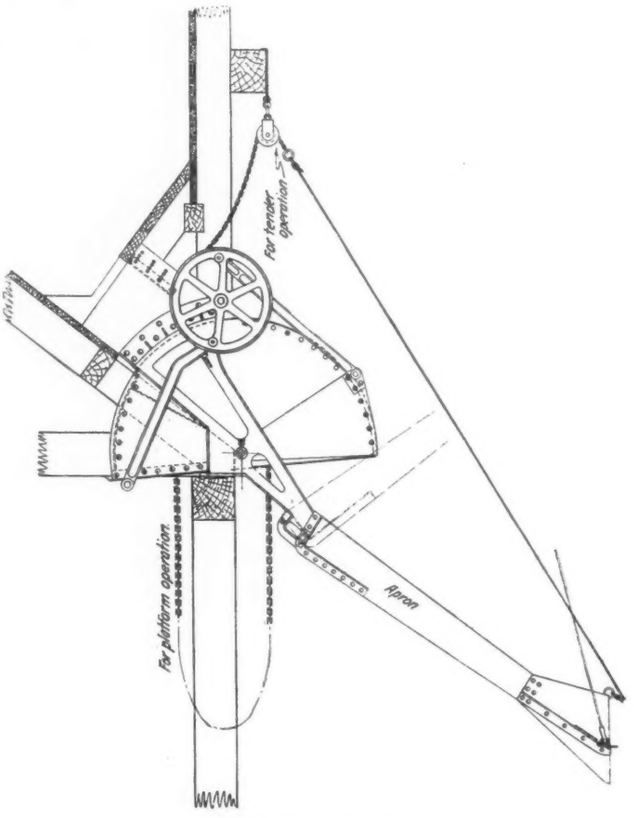
Device for Coaling Stations

in view of its being attached to existing structures without any appreciable alteration to them. It has also been designed to conform to standard track clearance lines.

DESIGN B

The measure is constructed in such a manner that it can be attached to the present stations without loss of elevation or standard clearance, as there is no change in the main slopes of the storage bin floor. The only change necessary is the side slopes and an additional small baffle over the measure, which can be changed at a nominal cost.

The measure is of half-cylinder design, pivoted in the center, with a gate at one end and a cut-off at the other. The bottom is provided with an additional plate extending from the cut-off to the center or pivot, and is located so that it continues the slope of the bin floor when in a filling position, also providing a very steep slope when the measure is in a discharging position, causing a quick delivery of the coal. The main bottom of the measure extends beyond the cut-off plate, and forms a pocket to catch the fine coal that might pass by the cut-off. All coal caught in the pocket is passed to the measure when discharged through the opening under the cut-off. The measure is held in position by a



Coal Measuring Device

pivot shaft which is attached to the bottom and passes through the two steel side castings, these castings being securely attached to the building at the pivot and upper end. The lower end of the side castings is provided with a cross-connection, and attached to same is a hinge or pivot to support the delivery spout.

The measure is operated through the link connections by rotating the sheave wheels, the links forming a toggle as the pivots pass over dead center, holding the measure in a locked position until the wheel is rotated by the operator. The measure is counterweighted sufficiently to cause it to return to the filling or horizontal position. The coal flowing into the measure causes the center of gravity to change to the front or discharging position, and it will immediately tip and discharge the load when unlocked, by rotating the wheel out of the toggle position. In the discharging of the coal or returning to a loading position, the link connection to the rotating wheel eliminates all slam or shock to the measure, as the movement is gradually reduced as the links pass over dead center. When the coal is discharged the measure automatically returns to the filling position and is again locked by the toggle links. The operation of the measure is produced by a slight pull on the rope or chain to rotate the wheel

causing the link pivot to pass dead center, the weight of the coal causing the measure to tip.

The capacity of the measure is one ton, and the movements are about eight to the minute. Attached to the measure is a recording device which records each issue to the engine, also a total record of the amount of coal passing through the chute. The measure is simple and strong in construction and cannot get out of order, and can be operated by hand from the tender or a platform, or power can be attached when desired.

The report was signed by: H. J. Slifer, chairman (Cons. Eng.); E. E. Barrett (Roberts & Schaefer Co.); H. B. Brown (Ill. Cent.); W. E. Dunham (C. & N. W.); J. C. Flanagan (Fairbanks-Morse & Co.); G. W. Freeland (Williams, White & Co.); W. T. Krausch (C., B. & Q.); R. A. Ogle (Ogle Const. Co.); J. L. Rippey (C., M. & St. P.), and A. Warner (Link Belt Co.).

DISCUSSION

The moral effect of weighing the coal on the tender of a locomotive was believed to have a very beneficial effect on the engine crew. Tests have shown that where the enginemen know that they are being checked upon the amount they use, a 10 per cent saving will result. It also serves to keep a more careful check on the condition of the locomotives. There was some disagreement regarding the measuring of the coal by volume as against obtaining the true weight of coal used. It was pointed out, however, that the volumetric devices could be adjusted for the different grades of coal used, so that the error would be slight. Tests on the type A machine shown in the paper, which was installed April 7 on the Nashville, Chattanooga & St. Louis, and had distributed 4,623 tons, showed that there was less than one per cent error per ton.

It was believed as necessary to weigh the coal into the coal chute as it was to weigh it out, as by this means a more definite check can be obtained on the coal used. In making adjustments for the overage or shortage, it was believed far better to adjust through a profit and loss account rather than to apply a correction to each individual engine, as it was much fairer to the engine crew.

A device for measuring the coal on the tender was mentioned by M. C. M. Hatch, of the Delaware, Lackawanna & Western, which was in the process of experimentation. He believed that this system would be of material advantage in that the men could constantly be informed as to the amount of coal they are using throughout the run. This device is such that the coal container in the tender is supported on diaphragms which are supported by a fluid. The pressure of this fluid is registered on gages which show the weight of the fuel container.

INTERPRETATION OF COAL ANALYSIS

BY E. G. BAILEY

The purpose and value of coal analysis should be better understood. The man who is responsible for the buying or burning of the coal accepts the figures from the chemist for the purpose of comparison, and proceeds to draw certain conclusions as to the relative value of the coals under consideration according to his own ideas of what the chemist's figures really mean. Very often these conclusions are not borne out by the practical road tests or the actual use of the coal in regular service.

It is regretted that too often the results of the chemical analysis are wrong, not by insignificant fractions of one per cent, but by several per cent or several hundred B. t. u. Very frequently the trouble is in the sampling, the original sample not being large enough to be truly representative, or else not having been properly reduced and pulverized. The methods of sampling and analysis recently proposed by committees of the American Society for Testing Materials* and the American Chemical Society, should be carefully considered.

The cost of fuel alone is not the sole criterion on which to judge the value of the fuel, for the character of the fuel has a great deal to do with the cost of repairs to grate bars, furnace linings and arches, and is of very great importance in the case of locomotive practice.

While the heating value of a fuel may be the item of primary importance, yet the effect of the non-combustibles upon the action of the coal in the firebox has such a modifying influence that very frequently the coal with the higher heating value gives the poorer results.

The usual analysis of coal gives the percentage of moisture, volatile, fixed carbon, ash and sulphur, in addition to the heating value. The moisture is of course a non-combustible. The principal importance of moisture is that it acts as so much inert matter, which is paid for at the same price as coal. This applies only to the moisture which is in the coal at the time of its being weighed.

According to the best authorities all of the oxygen which occurs in coal and which is not shown in the analysis as moisture is included in the volatile. By dividing the volatile matter of a typical West Virginia gas coal into its different elements, hydrogen, oxygen, carbon, nitrogen and sulphur, it is found that in the volatile there is a total of 5.38 per cent of the total coal, or about 13 per cent. of the volatile, that is water, besides some nitrogen and sulphur as non-combustibles. Making a similar division of the proximate analysis of a typical Illinois coal, we find that 9 per cent of the total coal occurs in the volatile in the form of water, or 25 per cent of the volatile itself is non-combustible. In the case of lignite and peat, the percentage of volatile which is non-combustible proportionately increases. So that in this we see that volatile itself is not an indication of rich locomotive fuel.

The question of clinkers is one of the very vital problems in locomotive practice. The whole question of clinkers can be summed up in the fusing temperature of the ash and the temperature to which this ash is subjected. Clinker accumulates gradually, and is more or less open and does not obstruct the air beyond the critical limit. But slicing or working the fire, causing the ash, which has already been liberated from the coal in the lower and cooler part of the fuel bed, to be again thrown up into the hotter zone, will melt it into a very fluid mass and obstruct the air flow to a serious extent.

Many people have considered that the percentage of sulphur was a true indication of the clinkering property of a coal. Sulphur is an indirect cause, however, for it is really the iron which has the effect upon the fusing temperature, and the percentage of iron usually increases or decreases with the sulphur. There are so many exceptions to the relation between sulphur, or even iron, and the clinkering property of coal, however, that a dependence upon either is apt to lead to erroneous conclusions.

The percentage of ash and its clinkering property is the critical factor to be considered in comparing the commercial value of different fuels of the same character. When it comes to comparing coals of different character practical tests are the only reliable means of arriving at comparative results.

DISCUSSION

It was generally agreed that ordinarily the sampling of coal was very poorly done which gave erroneous results. A mechanical sampling device being tested at the University of Illinois was believed to satisfactorily solve this difficulty. Some advanced the idea that the oxygen compounds were of

*Proceedings American Society for Testing Materials. Volume XV. Part 1. Also Year Book 1915.

advantage in that they assisted in the combustion of the coal. The trouble from clinkering will be materially reduced if sufficient air is allowed to pass through the grates and thoroughly oxidize the iron content in the coal. One coal operator believed that the best results would be obtained from analyzing the coal at the face of the mine, determining the percentage of foreign matter in the vein and using this as a check on the fuel delivered, inspections being made occasionally of carloads of coal to determine the percentage of foreign matter.

FUNCTIONS OF A RAILROAD FUEL INSPECTOR

BY EUGENE McAULIFFE
General Coal Agent, St. Louis & San Francisco

The function of the fuel inspector will vary with the conditions surrounding the source of the railroads' fuel supply. For convenience I will attempt to divide the more important duties of the inspector under certain subheadings:

What Constitutes Inspection.—Assuming that the inspector has been provided with copies of contracts, the enforcement of grade specification still remains in so far as results are concerned, a relative matter; in other words, the ideal can only be attempted, and the degree of success attained is best determined by comparison. The greatest controllable losses in quality of fuel lie in the direction of excess moisture and ash content, and where sulphur and its concomitant refractory ash making constituents occur in large quantities, a general attempt at excess ash control will usually in turn keep all such down.

It is entirely possible to equip every fuel inspector with simple apparatus and a formula easily understood, which will make the determination of ash and moisture content within reasonable limitations easily obtainable. United States Geological Survey Bulletin No. 621-A, "Field Apparatus for Determining Ash in Coal," by C. E. Lesher, Department of the Interior, U. S. Geological Survey, describes in simple language the apparatus and practice necessary to conduct this test.

Car Supply.—When cars are placed and the men are in the pit and on the tipple the production of a coal mine may commence; at the moment the car supply is exhausted the mine stops producing. No man can do more to raise the standard of this branch of mine service than can the competent fuel inspector, who works closely with the yardmaster, despatcher or superintendent who handles this work. The time lost by holding cars at mines, including delays incident to cars left over, empty or partially unloaded, unbilled loads, etc., is astonishingly large; an average delay of five or six days in moving all cars in and out of many mining districts is not uncommon. No railroad can own an average capacity coal car at an expense of less than 60 cents per day, counting interest, depreciation, taxes and repairs; too many men confound the agreed per diem rental with the cost of owning a coal car; they are dissimilar quantities, and when cars are in sharp demand $2 to $3 per day is not an excessive value to put on one.

Proper Carload Weighing.—The fuel inspector can assist materially in improving the standard of track scale weights, particularly when weights are made on scales located near the tipple. Perhaps the greatest service that he can confer on the traffic and operating department is that of assisting in the enforcement of the work of loading coal and coke cars to their full carrying capacity.

Inspection of Anthracite Coal.—A sufficiently competent inspection of a limited tonnage of anthracite can be made by:

(a) Observing the per cent of coal under size, including pea and buckwheat sizes.

(b) Note the percentage of rock or slate, readily removable, that is mixed with the coal.

Inspection of Fuel Oil.—Fuel oil should be purchased under specifications, and the inspector should be provided with a standard Fahrenheit thermometer, a Baumé or specific gravity gage and a standard centrifuge testing machine. The thermometer is used to determine the temperature of the oil in storage tank or tank car, and when it varies from 60 deg. F. due allowance in gallonage should be made from a basis of 60 deg. F. The centrifuge testing machine, easily managed, is used to determine the percentage of water and sediment contained in the oil. Unless care in unloading is exercised many cars will go back to the loading rack with a material amount of oil left in them; this due to unloading cars standing on grades, carelessness in cold weather, etc.

General.—A fuel inspector who is competent will organize his work and indirectly create a staff of helpers at each mine or storage pile. The fuel inspector should be able:

(a) To establish a proper standard of quality.

(b) To measure results quickly and accurately.

(c) To make the mine employees his willing helpers.

(d) To impress all with the fact that it is not his desire or intention to spend one day on one certain coal tipple, the next on another, and so on to the end of the month, getting a 10 per cent result, but on the other hand, to establish and secure automatically a standard of efficiency instead.

THE HUMAN FIREMAN

BY RALPH BRADLEY
Inspector of Fuel Service, Boston & Maine

There are two big problems in the efficient operation of the motive power department of a railroad—the "mechanical" and the "human" problem. In the mechanical problem we find that the machine (let us say a locomotive or an automatic stoker) has no initiative; it will not run itself, but power must be generated and furnished from some separate source. With the man (let us say a fireman or an engineer), however, it is a different problem. Initiative or power is a part of him and cannot be supplied from the outside. It is a man's will and mind and nervous system which provide the power to make him do the work, and the adequacy of this impelling force and its transmission to the physique is just as necessary to the man as the power is to the machine. Just as careful specifications, examinations and tests should be made covering mental and nervous processes of employees in engine service, as are made covering the generation of mechanical power, and the sooner such steps are taken the sooner will a great light be shed on the mystery of the "human equation."

We hear it said that men are not the "same class" today as they used to be. There are just as many good men as before if you want to get them. If we do not get them, it is because we do not attract them, which is not their fault, but the fault of the job or the fault of the employer.

Why should not the new firemen be examined as to their mental and nervous qualifications? It is the mental traits and disposition which are the essential ones. The mind and nervous system lie beyond and control the action of everything which the surgeon examines.

Theoretic training, though not indispensable, should be given greater prominence than heretofore, if 100 per cent efficiency is to be approximated. Assuming that the candidate for fireman is chosen or at least held as a student, he should be trained in theory. The fact that he is not a high school or a university graduate, and probably has small appreciation for theory, is no reason why he should be spared the work of learning important theories. The normal man has the curiosity instinct, which we have all inherited from our savage ancestors. If you do not tell him the "why" he is very apt to work out some theory of his own, with extraordinary results. The ordinary run of men are more inclined to absorb through oral instruction, visualization and practical demonstration than by literature. For this reason it is diffi-

cult to conceive a more practical method of imparting theories than by use of the lecture and demonstration car.

Whereas theoretic training is to explain *why,* practical training is to explain *how.* Practical training of a new fireman is indispensable, and specially so at the very start. It is far more important that the fireman should habitually strive to keep his fires as light as is consistent than that he should grasp the scoop in this way or that. It is far more important he should habitually study the condition of his fire and strive to place each scoopful of coal on that part of the fire bed where it will do the most good than that he should fire according to some system. The best practical training to fit a fireman to meet the variable conditions always present in locomotive operation is on the deck of the engine.

The first five trips of the new man on the engine are his habit-forming trips; they are more important in their effect on the direction of his habitual attitude toward his work and toward the welfare of the company, and in their effect on his sense of duty and responsibility and on his character than any other five trips of his life. Not every road can afford to carry enough road foremen or assistant road foremen or fuel supervisors (call them what you will) to accompany each new man for five trips, nor is it necessary; but no road should under any circumstances permit a new man to make his student trips with any but the very best engine crews.

The fireman should be required to pass a series of progressive examinations dealing with questions pertaining to both theory and practice in locomotive and train operation. At the same time he should be required to pass a physical and mental examination under a specialist, particular attention being given to a test of both sight and hearing. It is not until such tests and examinations have been made, and the result combined into some compact and readily available form, that a railroad can claim to have inspected the condition of its firemen with any degree of completeness.

Unless supervision and inspection under service conditions is much closer than it has been in the past, countless opportunities to commend efficiency and criticize inefficiency will continue to be lost, and with the same effect. The individual fuel performance statement, either with or without bonus, provided it is thoroughly reliable and gives credit for all the many factors entirely beyond the control of the fireman, is an excellent method for encouragement; but unless the fireman has the utmost confidence in the accuracy and fairness of the figures, even though the man who orders their compilation thinks them perfect, the statement fails to encourage, and may even discourage. It is an indisputable fact that the least laborious and most economical way to fire a locomotive is according to correct principles.

A series of interesting tests was conducted by two large eastern railroads, covering this feature of this subject. On each road a careful record was kept of the fuel performance of ten firemen on a number of trips under similar conditions. On part of the trips the firemen were unaware that they were under observation, whereas on the balance of the trips the test conditions were apparent. The following results, expressed in percentage, were obtained.

Average of test trips, Road A	100
Average of test trips, Road B	100
Average of service trips, Road A	131
Average of service trips, Road B	133

For one reason or another, the variety of duties which a fireman used to be required to perform have been reduced in number, so that today the fireman has as his particular job but one object—to maintain full pressure and to make the fuel supplied to the firebox evaporate into steam as much water as possible. As expressed by President Buell, "There is nothing more discouraging to a good fireman than an engine that will not steam properly. But a poor steamer seems to have some hypnotic effect on a poor fireman or a new man that not only causes him to forget everything he has ever known or heard about correct principles of firing, but suggests that he is no longer a fireman, but merely a coal heaver —and he acts on that suggestion." If the co-operation of the fireman is desired, co-operation must be given.

DISCUSSION

In the matter of hiring men for the position of locomotive firemen, it was believed that too much care could not be taken in selecting the right kind of men. The hiring should be done by experienced men, such as road foremen, master mechanics, etc., and a record should be kept of applicants most suitable for the work so that they may be called upon on short notice. The new men should be required to work in the roundhouse a sufficient time to familiarize themselves with the work required to be done on a locomotive. The locomotives should be maintained in proper condition, for a poor steaming engine will discourage the engine crew in making any attempt to save fuel. Instruction books and reading matter, if properly handled, it was believed would be of considerable assistance to the firemen. Only by treating the men in a fair, intelligent way is it possible to obtain the proper co-operation.

OTHER BUSINESS

Two other papers which interested particularly the transportation department were presented; one by W. H. Averell on "What the Transportation Official Can Do to Promote Fuel Economy" and the other by J. G. Crawford on "Coal Distribution Record System."

A paper was also presented by A. G. Kinyon of the Powdered Coal Engineering & Equipment Company on the "Influence of Intimate Knowledge of Coal on Fuel Economy Efforts of Enginemen and Others." Mr. Kinyon performed practical experiments showing how the constituents of coal may be burned efficiently. A half a pound of coal slightly dampened was heated in a retort and it was shown how the moisture was driven off before any of the volatile matter. The gases coming off from the coal were burned, and it was shown how with inefficient air supply considerable smoke was produced. This gas was also passed through a scrubber removing all impurities, and it was also shown how this colorless volatile gas could be made to burn, producing smoke by being in contact with a cold surface. It was believed that if such experiments were shown to the men actually handling locomotives it would give them a clear idea of the properties of the fuel they have to deal with.

Progress reports were submitted by the committee on Fuel Tests, Fuel Accounts, and on the Storage of Coal. The Committee on Fuel Tests reported that about $2,000 has been obtained for the purpose of conducting the tests at the University of Illinois testing plant, and that the committee had been assured of the co-operation of the University of Illinois and the United States Bureau of Mines. George A. Post, president of the Railway Business Association, made an interesting address at the annual banquet.

The secretary-treasurer reported a total membership of 636 and a cash balance of $1,940.11 up to May 1, 1916. During the convention 68 new members were enrolled. The proportion of attendance at the convention to the total membership was greater than ever before in the history of the association. The following officers were elected for the ensuing year: President, W. H. Averell, general manager New York properties, B. & O.; vice-presidents, E. W. Pratt, assistant superintendent of motive power and machinery, C. & N. W.; L. R. Pyle, fuel supervisor, M., St. P. & S. S. M., and W. L. Robinson, supervisor fuel consumption, B. & O.; executive committee, for two years, A. N. Willsie, C. B. & Q.; T. Duff Smith, G. T. P.; R. R. Hibben, M. K. & T.; Ralph Bradley, B. & M.; C. M. Butler, A. C. L.; for one year, William Schlafge, Erie Railroad, and W. K. Kilgore, C. M. & St. P. Chicago received the largest number of votes for the next place of meeting.

LOCOMOTIVE IMPACT TESTS

By C. B. YOUNG

Mechanical Engineer, Chicago, Burlington and Quincy

The Chicago, Burlington & Quincy purchased seventeen 2-10-2 type locomotives in 1914 and 1915, and 15 Pacific type locomotives in 1915, which were built with reciprocating parts made of special heat treated steel in order to reduce the amount of counterweight ordinarily required to balance these parts. Last September impact tests were conducted on a three-track 63-ft. plate girder skew span bridge to determine the effect these locomotives had on bridges and track in comparison with locomotives of approximately the same size and design with reciprocating parts made of ordinary steel. In making the tests the railroad company was assisted by W. S. Kinne of the University of Wisconsin, who has had considerable experience in tests of this nature.

DESCRIPTION OF THE LOCOMOTIVES

Four locomotives were used in the tests, two of the 2-10-2 type and two of the Pacific type. The locomotive of the 2-10-2 type provided with the special heat treated steel reciprocating parts is designated as M-2-A and the other having the ordinary steel, as M-2. Similarly, S-3 designates the Pacific type locomotive having the special heated treated steel reciprocating parts and S-2 the locomotive of the same type using the ordinary steel for these parts. Both of these types have been described in the *Railway Age Gazette,* the 2-10-2 locomotives in the issue of August 13, 1915, page 275, and the Pacific type locomotives in the issue of August 28, 1914, page 387. The locomotives are of the following general dimensions:

The M-2-A locomotives have .40 per cent carbon steel (electric process) pistons and crossheads (the crossheads being of the Laird type to reduce the weight), Nikrome steel piston, main and side rods, Nikrome steel main crank pin and nickel steel crosshead pins. The S-3 locomotives are similarly equipped with the exception of the crosshead pins which in this case are of Nikrome steel. The piston rods on both engines have a 2½-in. hole through the core and the maincrank pin a 4-in. hole. On the M-2-A locomotive the weight of the reciprocating parts is 379 lb., or 16 per cent lighter than the reciprocating parts on the M-2 locomotive. Similarly the weight of these parts is 73 lb. (5.33 per cent) lighter on the S-3 locomotives than on the S-2 locomotive. While the difference in this case appears small it must be noticed from the table below, that the S-3 locomotives are heavier and more powerful than the S-2 locomotives.

The M-2-A locomotives were built with these light reciprocating parts for the purpose of decreasing the effect on the track of the heavy counterweight required by the M-2 locomotives and to eliminate the use of the bob weights which were applied to the driving axles of the M-2 locomotives as a necessary addition to the counterweight in the wheels, the size of the wheels being such that the entire counterweight could not be contained therein. The S-3 locomotives were built with the light reciprocating parts for the purpose of obtaining heavier and more powerful engines than the S-2 locomotives without increasing the impact effect of the wheel load and counterweight on the track.

	2-10-2		Pacific	
Class	M-2A	M-2	S-3	S-2
Reciprocating parts	Light	Ordinary	Light	Ordinary
Total weight	367,850 lb.	377,100 lb.	266,400 lb.	226,100 lb.
Weight on drivers	295,950 lb.	300,700 lb.	169,700 lb.	153,100 lb.
Size of cylinders (diameter and stroke)	30 in. by 32 in.	30 in. by 32 in.	27 in. by 28 in.	25 in. by 28 in.
Boiler pressure	175 lb.	175 lb.	180 lb.	165 lb.
Diameter of drivers	60 in.	60 in.	74 in.	69 in.
Tractive effort	71,500 lb.	71,500 lb.	42,200 lb.	35,600 lb.

TEST METHODS

In order to determine the actual conditions existing for the locomotives under comparison, recording extensometers were used to measure the actual stresses in the girder flanges of the bridge, and the actual deflection of the girder was determined by means of a recording deflectometer. A comparison of the stresses and deflections caused by any two locomotives gives an idea of their relative impact effect. In order to secure data from which a comparison can be made as to the relative impact effect of any two locomotives, it is necessary to realize certain conditions. The speed at which the two locomotives are run must be equal, and the counterweights on both locomotives must be in such a position that their maximum downward thrust due to centrifugal force is exerted at the same point on the bridge. The method followed for obtaining the data was to determine the points on the bridge at which the counterweight was in the down position and to determine the speed at which the locomotive was running. In making comparisons, records were selected from the test runs where the locomotives to be compared were running at the same speed, and where the counterweights came down at the same point on the structure.

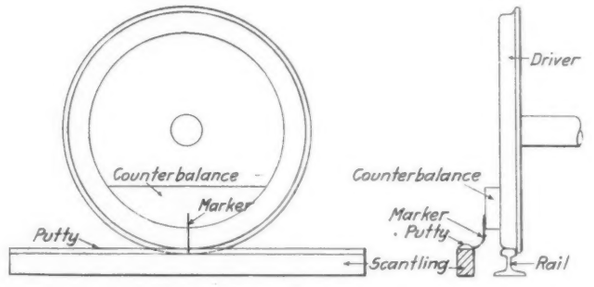


Fig. 1—Arrangement for Determining Location of Counterbalance Relative to the Center of the Bridge Span

The determination of the position of the counterweights was accomplished by placing a marker on the counterweight of the main driver. Alongside the rail was placed a scantling with a strip of putty on its upper edge. The scantling was so placed that the marker on the counterweight made a mark in the putty as the locomotive passed over the bridge. (See Fig. 1). The span center was used as a reference point, and the position of the counterweights is given in feet east or west of the span center. This information is given in the tables under the columns headed "C. B." Another column gives the speed in miles per hour at which each run was made. These speeds were determined by a stop-watch timing over a 1,000-ft. base line.

The detail results were worked up from the records of the recording extensometers and the deflectometer. By scaling the maximum ordinate from each record, the maximum flange stress or deflection caused by the locomotive is obtained for the test run in question. These are given under "M" in the tables. To obtain the impact effect the stress or deflection caused by the locomotive running at high speed is to be compared with values caused by the same locomotive running at low speed. These low speed records were taken for the loco-

motive crossing the bridge at a speed of about 5 m. p. h., for it has been found that at this speed the centrifugal force due to the counterweights is practically zero. In each series of test runs for a certain locomotive, the first and last runs were made at low speed, and are called "static" runs. The average values for these static runs are given in the columns of the tables headed "S." By subtracting these static values from the maximum values the excess due to the centrifugal force of the counterweights is obtained. In the tables these values are given in the columns headed "E." Finally, by dividing the excess by the static values, the "impact per cent" is obtained, the values of which are given in the columns headed "per cent E."

The instruments used in making the tests were two recording extensometers and one recording deflectometer. A complete description of these instruments is given in Bulletin No. 125 of the American Railway Engineering Association. The instruments were placed at the center of the top flange of the north girder supporting the center track. Extensometer No. 11 was placed on the north edge of the flange, and Extensometer No. 12 was placed on the south edge of the flange. The deflectometer was placed at the center point of the top flange of the girder.

TABLE I—DATA FOR COMPARISONS BETWEEN CLASS M-2-A AND M-2 LOCOMOTIVES

				Extensometer No. 11				Extensometer No. 12				Deflectometer			
	Class	Speed, m. p. h.	C. B.	M	S	E	Per cent E	M	S	E	Per cent E	M	S	E	Per cent E
A	M-2-A	41.1	6.1 W	7,730	7,020	710	10.1	4,640	4,450	190	4.3	0.275	0.260	0.015	5.8
	M-2	41.1	5.8 W	8,800	7,020	1,780	25.3	4,840	4,520	320	7.1	0.305	0.258	0.047	18.2
B	M-2-A	44.9	7.0 W	8,100	7,020	1,080	15.4	4,720	4,450	270	6.1	0.275	0.260	0.015	5.8
	M-2	39.6	7.7 W	9,280	7,020	2,260	32.1	5,030	4,520	510	11.3	0.315	0.258	0.057	22.0
C	M-2-A	38.3	3.8 E	8,330	7,020	1,310	18.6	5,030	4,450	580	13.0	0.305	0.260	0.045	17.3
	M-2	39.6	2.8 E	9,350	7,020	2,330	33.1	5,550	4,520	1,030	22.8	0.315	0.258	0.057	22.0
D	M-2-A	42.1	2.3 E	8,270	7,020	1,250	17.8	5,420	4,450	970	21.8	0.300	0.260	0.040	15.4
	M-2	41.1	2.0 E	9,760	7,020	2,740	39.0	5,940	4,520	1,420	31.4	0.345	0.258	0.087	33.6

Values for extensometer given in lb. per sq. in. Values for deflectometer given in inches.

TABLE II—DATA FOR COMPARISONS BETWEEN CLASS S-2 AND S-3 LOCOMOTIVES

				Extensometer No. 11				Extensometer No. 12				Deflectometer			
	Class	Speed, m. p. h.	C. B.	M	S	E	Per cent E	M	S	E	Per cent E	M	S	E	Per cent E
A	S-2	68.2	3.8 W	6,600	4,820	1,840	38.2	5,940	3,805	2,135	56.0	0.255	0.195	0.060	30.7
	S-3	68.2	3.7 W	6,300	5,120	1,180	23.0	5,030	4,260	770	18.1	0.260	0.205	0.055	26.8
B	S-2	66.9	1.5 W	6,600	4,820	1,840	38.2	5,160	3,805	1,355	35.5	0.245	0.195	0.050	25.6
	S-3	68.2	1.6 W	6,600	5,120	1,540	30.0	4,900	4,260	640	15.1	0.250	0.205	0.045	22.0
C	S-2	66.9	7.0 E	5,830	4,820	1,010	21.0	4,520	3,805	715	18.8	0.275	0.195	0.080	41.0
	S-3	66.9	6.7 E	5,950	5,120	830	16.2	4,900	4,260	640	15.1	0.260	0.205	0.055	26.8
D	S-2	66.9	9.2 W	6,600	4,820	1,840	38.2	5,290	3,805	1,485	39.0	0.260	0.195	0.065	33.3
	S-3	68.2	9.3 W	6,600	5,120	1,540	30.0	5,420	4,260	1,160	27.3	0.275	0.205	0.070	34.1

Values for extensometer given in lb. per sq. in. Values for deflectometer given in inches.

RESULTS OF TESTS

Locomotives M-2-A and M-2. Four test runs were obtained from each locomotive from which comparisons can be made. The data from these runs are given in Table I. This table shows that the maximum stresses, deflection and impact are less for the M-2-A locomotive than for the M-2 locomotive notwithstanding the fact that the static values are equal. This, of course, is due to the light reciprocating parts of the M-2-A engine. The maximum impact obtained for the M-2-A engine during the tests was about 22 per cent and for the M-2 engine, 35 per cent. In both cases the speed was about 40 m. p. h.

Locomotives S-3 and S-2. Four test runs were obtained from each locomotive from which comparisons can be made. The data for these runs are shown in Table II. Engine S-3 has a greater static value than engine S-2, but notwithstanding this the maximum stresses and deflections shown are practically equal in all cases, indicating that, regardless of the difference in static value or the weight on drivers, the engines have the same effect on the track.* This is due to the lighter reciprocating parts on the S-3 engine. Test runs at speeds exceeding 75 m. p. h. were made with both locomotives, but as the counterweight positions were not similar no comparison can be made. It seems probable, however, that the conclusions reached from Table II still hold true for high speeds. At 65 m. p. h. the maximum observed impact for the S-2 locomotives was from 35 to 40 per cent and for the S-3 locomotives from 30 to 35 per cent. As stated above, in designing the S-3 engines, it was desired to produce an engine of greater tractive effort and greater weight on drivers than the S-2 engine, without producing greater stresses on track and bridges. These tests developed that the S-3 engines having 16,600 lb. greater weight on drivers and 6,600 lb. greater tractive effort, actually produce less stress on track and bridges than the lighter S-2 engines with which they were compared.

General Conclusions. Where the locomotives are of equal weight, the locomotive with heat treated steel moving parts is not as hard on bridges and track as a locomotive with ordinary steel moving parts. The use of heat treated steel moving parts allows the addition of considerable weight on the drivers over that used in a locomotive with ordinary steel moving parts without increasing the total effect of the locomotive on bridges and track.

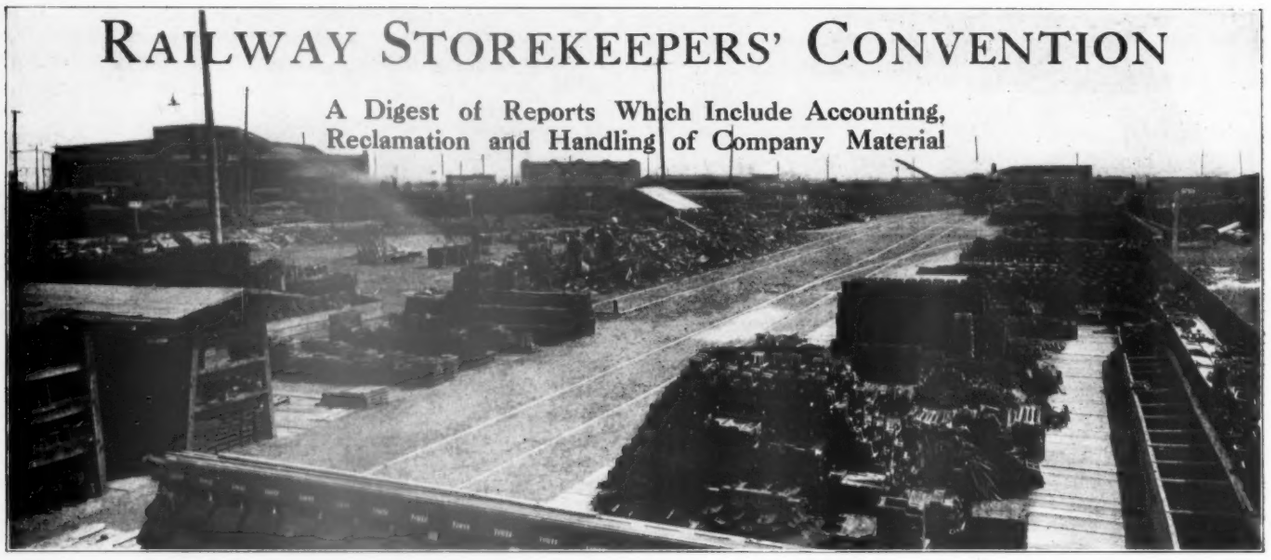
*The fact should not be overlooked, in this comparison, that the two locomotives have driving wheels of different diameter.—ED.

OTHER TESTS

In addition to the above report on impact tests, attention should be called to the very thorough investigation made of this subject by the American Railway Engineering Association which was published in its Bulletin No. 125 in 1911. This report includes an account of tests made with two Burlington Atlantic type locomotives, one of which was a balanced compound having a weight of 51,000 lb. on the main driving axle. This engine was tested on a Pratt truss, pin connected single track bridge of 132 ft. span and a maximum percentage deflection of 15 per cent was obtained at a speed of 46 m. p. h. at the center of the span. At 58 m. p. h. the maximum speed at which this engine was run, the percentage deflection was 14 per cent. For comparison a test was run on a single expansion engine of the same type, having a weight of 46,500 lb. on the main driving axle, over the same bridge. This engine showed a maximum percentage deflection at the middle of the span of 26 per cent at a speed of 52 m. p. h., which was but 2 m. p. h. less than the maximum speed made by that engine during the tests. It will be understood that a legitimate comparison cannot be made between these tests and those relating to the Pacific type engine described above, due to the vast difference in the length of the spans of the two bridges, and to the difference in weight of the locomotives.

RAILWAY STOREKEEPERS' CONVENTION

A Digest of Reports Which Include Accounting, Reclamation and Handling of Company Material



Reclamation Yard, Seaboard Air Line, Portsmouth, Va.

THE thirteenth annual convention of the Railway Storekeepers' Association was held at the Hotel Statler, Detroit, Mich., May 15, 16, 17, President J. G. Stuart, general storekeeper of the Burlington, presiding.

The invocation was offered by Rev. C. B. Emerson, after which the association was welcomed to the city by Hon. Oscar B. Marx, mayor of Detroit.

In his opening address President Stuart emphasized the continued need of economy. Material should be used to the very best advantage, as the railroads are now confronted with industrial conditions differing from any previously experienced. The manufacturers are doing their best to meet the demand for material, but the demand greatly exceeds the supply, so that special efforts must be made to obtain the best possible service from material now on hand and that which is received.

The work of the storekeeper is continually broadening and in selecting a man for promotion he should not be chosen simply because he has filled a certain position, but because he has filled it in such a way as to impress his superiors with his ability to handle something larger. The storekeeper should get around and familiarize himself with conditions and needs in the various departments, and study the conditions under which the work is done, so that he will realize fully the need or the lack of need of material that is ordered. Attendance at the conventions and participation in the discussion can aid greatly in helping the storekeeper to give what is demanded of him—service.

The secretary-treasurer reported a cash balance of $171.80, and an active membership of 791.

PIECE WORK

There was no committee report on piece work, but several members gave the results of their experience. D. C. Curtis of the Burlington stated that care should be taken to get the prices right in starting. There should be no mystery made of it with the men; under these conditions a piece work system will hold laborers with less shifting than day work. Do not try to change prices unless conditions are changed. J. H. Waterman of the Burlington gave it as his opinion that prices should be made so carefully at starting that there will be no need to readjust downward, which frequently causes dissatisfaction among the men.

It has been found on the Rock Island that piece work laborers stay longer with the company than do men employed at a day rate. This road pays its foremen an hourly bonus for work done during the time a gang is working on piece work.

ACCOUNTING

The accounting committee made the following recommendations:

That detail accounting be done by storekeepers at storehouses where the material is actually disbursed, and original requisitions be retained by them, except at outlying points under jurisdiction of employees of other departments, or where issues are so small that it is unquestionably desirable for accounting in connection therewith to be done at the division store controlling the territory, or at some other central store.

That storekeepers, where accounting is done, make distribution by values to primary operating accounts, operating divisions, main and branch lines, states, etc., and render necessary reports covering this and other accounting functions direct to auditing departments or thereto through higher store department consolidation offices, at the option of the carrier.

That as this association, in its convention at St. Louis in 1910, recommended basing the comparison of efficiency of operations on the unit of stock on hand and disbursements for actual use or other final disposition, reports of such operations shall be segregated according to the material classification adopted by this association, so that in such reports the materials or classes handled by the store department of each road will stand out clearly and can thus be compared intelligently with any other road in classified form. Thus any groups not handled by one road would be omitted and we would not endeavor to compare one property with another as regards materials which are handled by the one road which are foreign to the store department jurisdiction of another.

That by reason of the present requirements of the Interstate Commerce Commission, all stocks of frog and switch material along the line shall be carried in stock and charged out on semi-monthly or monthly reports from the track department as to actual applications, such material to be included in the regular inventories and any discrepancies not previously discovered adjusted in connection therewith.

That stock records be maintained covering such material and monthly checks made to see that all applications are reported.

That material provided for A. F. E. work be carried in

stock and charged to the work on reports from those in charge of actual use; such reports to consist of diaries at completion of small jobs (done in two weeks to thirty days) and semi-monthly or monthly diaries covering material used on large jobs.

That charges as made show price, point of origin, and actual weight of each item.

That an inventory of contract oils and greases be taken the first of each contract adjustment period at all points where such are issued for use and a statement prepared showing the quantities on hand from preceding reports; receipts during the period; total to account for; issued; en route; and balance on hand at end of period, the latter being represented by an actual check.

The difference between the amount on hand by inventory and the amount on hand by total to account for less issues, to be adjusted over the issues, on a pro rata basis. These reports to be substantiated by oil requisitions covering issues and receipted shipping notices covering receipts. The reports after being checked, to be consolidated for the entire railroad and one adjustment made on the consolidated report. Report of the oils and greases issued to be made by classes of service to the oil company at the end of each period. The oils and greases used for breaking in locomotives, and for the initial packing of boxes, to be included in issues.

A tentative schedule of bases for second-hand prices was submitted to the convention and will also be submitted to the Association of American Railway Accounting Officers.

The report is signed by H. C. Stevens, H. H. Laughton, D. R. Elmore, C. A. Miller, W. E. Brady and W. L. Hunker.

Discussion. — Several members did not agree with the percentages given by the committee. The report was referred back to the committee with instructions to substitute for the list given, a price for second-hand material of 100 per cent of the new cost, less the cost of repairs, except on certain specified items. The report was changed to conform with these instructions.

J. G. Stuart, President,
Railway Storekeepers' Association

MARKING OF COUPLERS AND PARTS

The committee on the Marking of Couplers and Parts presented a progress report. The committee has been in communication with the manufacturers, and many items included in the 1915 report have been eliminated due to obsolescence. The members feel that all manufacturers should use the numbers recommended by the committee.

SCRAP AND SCRAP CLASSIFICATION

A number of inquiries were made as to the disposition of scrap glass. The result of the committee's investigation developed that there is a market for scrap glass and it can be disposed of in accordance with Item 85A—R. S. A. standard scrap classification. This glass must be clean in every respect; if any colored or dirty glass is mixed with the clear glass, the purchaser will not accept it.

If a carload lot can be accumulated from time to time it can be disposed of at any glass works. All of this glass is sold f. o. b. works and will net from $2.50 to $3.50 per ton. In large cities there are generally one or more scrap dealers who will take glass, delivered in small lots, netting about $1.00 to $2.00 per ton, according to the market price.

It is the opinion of the committee that close supervision should be given to the handling of glass, and that it should be disposed of under rigid specifications in order that a loss will not result.

Scrap paper, such as accumulated by railroads, is worth from $7.00 to $10.00 per ton disposed of to scrap dealers, etc., in cities where it is accumulated.

By the proper supervision in handling of scrap paper a considerable saving can be made. In large cities a contract can be made with some dealer to furnish sacks, and a place set aside so that all paper from offices can be accumulated and put in the sacks belonging to the dealer. The dealer comes at intervals for the paper accumulated, leaving empty sacks to take care of further accumulation.

There is on the market a baling press for scrap paper which could be located at some large outside freight house and agents could save all paper, then forward it to this point in local shipments by sacks. It could then be put in this press and baled from time to time. This press could be stationed in one corner of the freight house. It is absolutely fire proof, made of metal and compresses bales weighing from two to three hundred pounds. After bales are pressed they are easily disposed of.

Where railroads are operating supply cars it would not be necessary to install a press at the larger stations, as outlined above, but agents could accumulate paper and hold it until the supply cars arrive. One of these presses could be installed in the supply car which could compress the paper and as fast as bales are accumulated they could be disposed of to the market direct.

The report is signed by W. Davidson, F. D. Reed, W. A. Linn, LeRoy Cooley, C. C. Dibble, A. R. Dale and R. L. Morris.

Discussion.—The members were urged to adopt and use the association's scrap classification. Some roads are selling scrap electric lamps, but the economy is doubtful owing to the difficulty of collection.

FILING OF CORRESPONDENCE

BY W. C. HUNT

An ideal filing system where every letter and every record can always be found is often advertised, but it has not been our good fortune to come in contact with such a system and for an office where there is a large volume of work, we do not believe such a system has been invented. There are, of course, various plans in use and they all have good points, consequently this is a subject which can be discussed from various angles.

The more simple we make the filing method, the more easily it is understood, but to make even the simple plan work we must supplement it with competent clerks in the filing room and with the proper facilities. A filing system for a store department must have a wide scope, as not only correspondence regarding material and accounting must be handled, but a great many other subjects come within the boundaries of this department.

Most of our correspondence troubles, it seems to me, are due to lack of supervision and a realization by the people who handle it of its importance. We know how annoying it is to call for a file of correspondence or a record and after search has been made to be told "It cannot be found"; or on the other hand, to have another department call for a reply to one of its letters and have to tell them "Cannot locate—Please send copy." This means waste of valuable time, and in most cases I believe it will be found that the system is not so much at fault as is a lack of proper supervision.

W. A. Summerhays, 1st. Vice-Pres. Railway Storekeepers' Association

Because we experience these difficulties does not necessarily mean that we ought to try a new plan or make a very radical change in our old one. To do this simply adds confusion and a further difficulty in locating papers after a little time has elapsed. You cannot always keep the same man in the filing room and changes are always occurring in the personnel of a large office. It is my belief, therefore, that any plan which has been given some thought in its original construction, with relation to the requirements of the department, will prove satisfactory, if it is given necessary supervision. We ought to analyze these troubles to see why they occur, teach the stenographers and others who handle correspondence the importance of placing proper filing references thereon, and to handle them promptly.

I would like to outline the method we have been using in the store department of the Atchison, Topeka & Santa Fe for a number of years. We have had our troubles but we did not discard the whole plan on account of the minor difficulties. We analyzed and corrected them as they came up, until we feel that the system now covers our requirements and we experience little trouble.

The method we are using is one which covers the entire store department of the railway, from the smallest division store to the largest general store, and the details pertain to our general store at Topeka, where we are receiving and sending on an average of 700 letters and telegrams per day, 225 invoices, 400 requisitions from the store and operating departments, to say nothing of all the mechanical departments' requisitions, various reports, etc.

Foremost, in any system, is the matter of supervision and we have provided this by having what we call a head filing clerk, who has three assistants, a mailing clerk, and under him also comes the office boy who distributes the correspondence to the different desks, etc., after it has passed over the chief clerk's desk. All incoming mail goes to this filing room, where it is opened, stamped and all correspondence pertaining thereto attached. All outgoing mail passes to this room for placing in envelopes and addressing, thus conserving the use of envelopes.

This method insures always having someone in the filing room who is familiar with the records and the method employed. The expense of maintaining this may seem large but it is small compared with the time lost under the old method of letting high priced clerks spend a great deal of their time looking for records.

Under our actual filing method, all subjects are arranged alphabetically and each subject is given a number. These subjects are sent, in printed book form, to all stores and we have endeavored to cover each class of material, report and statement under its respective subject. We have found that we can cover practically all subjects in less than 600 numbers and under any subject where the amount of correspondence is voluminous we make a further separation, arranging such separation alphabetically.

As an example of how this plan is arranged under the alphabetical and numerical arrangement, file No. 1 is Abrasives, No. 2 Acids, No. 3 Air Brake, No. 14 Locomotive Parts, No. 21 Mechanical Lumber, No. 22 Bridge and Building Lumber, and so on, until we reach No. 584, Zinc. These subjects are also cross indexed, as under the alphabetical arrangement, the same class of material may properly appear under two different letters. To make this clear, we will take file No. 1, Abrasives; the subject covers a number of articles and under it ground emery will appear under the letter "E," file No. 1; Pumice Stone under the letter "P," file No. 1, and so on, until each class of material is covered. In addition to the printed book of these references which is sent to each store, a copy is furnished each stenographer, thus insuring all correspondence being carried under its original number and subject to its completion.

It would seem under the method outlined that some of the files would become exceedingly large, but as I have before stated, we get around this difficulty by arranging the file alphabetically under its respective number where the amount of correspondence warrants.

We have further divided this system into two parts, one which we call the "Open File" and the other the "Closed File." Under the first heading, we keep under the jurisdiction of the filing clerk all correspondence that is awaiting a reply or is not complete. In this way a systematic check can be kept on correspondence which is not closed and also a regular follow-up plan maintained.

Under the second heading we keep all correspondence which is closed and is of no further use, except as reference. This closed correspondence is also kept under its proper date order. We follow this plan further when incoming mail has been opened, stamped and files pertaining thereto attached; it is passed over the desk of the chief clerk for check and distribution. This enables the chief clerk to keep posted on everything that is going on, as the files are complete when they pass over his desk. At the same time the filing clerks can be held strictly accountable for all the records. Under this plan, of course, no clerk is allowed to keep any files or closed records on his desk. They must all be sent to the file room to be placed either in the "Open" or "Closed" file.

J. P. Murphy, Sec.-Treas. Railway Storekeepers' Association

To work this method it is necessary to have the proper facilities and these we have provided at our general stores by having a separate filing room. These rooms are arranged with shelving, cases, etc., to take care of our needs. Neatness is one of the essential points in any filing room and to instill this into the minds of the people who handle this work, we paint all shelving cases, etc., with white enamel and provide them with the other necessary facilities, such as proper filing boxes to take care of the letters, requisitions, invoices, reports, etc.

In this room we keep all duplicating machines for getting out circular letters, bulletins, etc.; also have a binding machine for binding reports, requisitions, invoices and other records. One thing which we attempt to do is to allow nothing to be tied into bundles. We bind everything we possibly can and properly stencil it. At the end of each year's business we bind all requisitions, invoices, etc. You cannot lose a requisition or an invoice in this manner and it can never get out of its proper place.

STANDARDIZATION OF TINWARE

W. F. Jones, New York Central, chairman of the committee on Standardization of Tinware, presented a final report stating that the standards of the association and those of the Master Mechanics' Association were now identical and that they would be found in the 1915 proceedings of the latter association. All roads were urged to take immediate steps to adopt these standards, as considerable savings can be realized because of the ability of the manufacturers to manufacture in large quantities and carry the various items in stock.

RECLAMATION

Reclamation has become one of the biggest words in store department work and the possibilities of enormous savings are becoming more apparent every day.

The storekeeper is the pioneer in this work, but on many roads the reclamation work has been started by him and turned over to the mechanical department for the reason that facilities were needed and by the argument that it would require a duplicate organization to do this work under the store department.

Before the storekeeper began this work, it was attempted in the shops, but was objected to for the following reasons:

First—The shops were organized to turn out power and could not break into their regular work.

Second—The cost of reclaiming with high priced mechanics would show no saving.

Third—Their supervision was given to turning out locomotives and cars, and this work must have first consideration.

Fourth—Reclamation without organization, and where considered secondary, without proper methods regarding costs and overhead, is expensive.

These arguments are admitted as true and are the strongest recommendation for a separate reclamation plant where the work can be efficiently handled, supervised, inspected, and costs given proper consideration. If the work is handled by the storekeeper, he will see that the material that is needed is reclaimed so as to prevent in every way possible the purchase of new material.

Supervision.—The handling of scrap on practically all roads is under the store department. Scrap is carried in the storekeeper's accounts and sales are made through him. The proper sorting and reclaiming, therefore, simply means the expanding of this work.

When sorting the scrap to classification for the purpose of obtaining the highest price, it is only necessary to have men who are acquainted with material to pick out the serviceable parts. The store department has men who are acquainted with material for all departments and are therefore valuable for this work.

Inasmuch as the store organization is provided with the necessary records, as regards the amount of material on hand and the amount used, it can be seen that there would be no money wasted in picking out material that was already in stock, surplus or more than needed, and instead of reclaiming useless material, will quickly turn this into money.

The store departments are already trained in the proper accounting and prices, and are placed in the position where they cannot reclaim material unless such work shows a profit. The users of material would always rather have new than second-hand, but when this material is handled by the storekeeper he will see that second-hand material is used first and in this manner provide an outlet for all that can be reclaimed and used.

The final measurement of a store department is its purchases, and it is interested in the use and any abuse of material. If this work is handled under the store department, a large percentage of the work and the handling of reclaimed material can be done by the regular storehouse force and by laborers and handymen. It is necessary when this work is handled by the mechanical department to do a good deal of it with mechanics and, in fact, the shop crafts would demand this work if done in the shops. Railroads, therefore, make a serious mistake in not taking advantage of using cheap labor in this work.

Handling and Sorting Scrap.—No railroad should sell scrap unassorted. Someone must sort and classify it before it is used and large quantities of serviceable material can be reclaimed from almost any car of scrap that will pay for the sorting.

Many scrap docks have just grown and the costs of doing the work have not been carefully considered or kept. Where from two to six thousand tons of scrap is handled per month, as is the case on the average road, the saving of ten cents per ton is no small item. Every road should keep these costs accurately so that they can be compared with other roads which have facilities, cranes, etc., and be able to show the savings which can be made by having the proper tools and facilities for doing the work.

The following statement showing costs of handling scrap will be of interest. It will be noticed that the roads that have gantry or overhead cranes are able to handle scrap cheaper than those equipped with locomotive cranes. The committee felt that these figures would be of interest to those roads which desire better facilities, cranes, etc., and which desire figures that will show what can be done.

STATEMENT SHOWING COST OF HANDLING SCRAP

Road	Cost per ton, old method	Cost per ton, new method	Average tons handled monthly	Cranes with Magnet
A	$0.40	$0.20	2,880	1 Gantry
A	.42	.37	7,000	1 Locomotive Crane
B	.50	.16½	6,000	2 Gantry
C	.57	.44	6,000	2 Locomotive Cranes
D	.52	.38	3,000	1 Locomotive Crane
E	50	.40	4,000	1 Locomotive Crane
F	.80	.60	2,500	2 Locomotive Cranes
G	1.25	.42	2,550	1 Locomotive Crane
H	....	.58½	2,000	2 Locomotive Cranes
I	....	.61	6,000	3 Locomotive Cranes
J	....	.24⅞	9,500	2 Locomotive Cranes

Road "A" has two plants and one equipped with Gantry crane reduced the cost 20 cents per ton.

Reclamation Plant.—In order efficiently to handle scrap, to know exactly what is being spent and to have the necessary supervision and force, it is desirable to have one reclamation plant on the average road, if the geographical location will permit. Local reclamation many times is carried too far, as no cost account is kept of the work and it is not properly supervised or inspected.

Centralized plants only will justify machinery and organization and keep a force constantly employed. Where material can be reclaimed at point of origin in the shops, cheaper than at the reclamation plant, it should be done, but there is great danger of duplicating work at point of origin as the work is not under proper supervision, and there is a tendency to work high price men. This work is also of secondary importance to the shops and does not receive the proper attention as regards costs, etc.

In laying out the reclamation plant, it should be designed so that the work will be progressive—in other words, so that the scrap will move one way and the good material go at once

to racks conveniently located and the material for reclamation move toward the proper machine without rehandling.

Many reclamation plants have just grown and are subject to criticism on account of the extra rehandling. Future needs should be considered so that as the different machines are added the whole plant will work as a unit.

The committee presents the following list of tools which are needed on practically every railroad handling even a small amount of scrap. These tools are in use at all points which have been doing this work and will save the greatest amount of money for the investment:

	Cost
1—Alligator shears for general run of scrap—motor-driven	$1,500
2—Vise, forge, emery wheels, small tools, for repairing jacks, drills, shovels, etc.	100
3—Brass magnetic separator—motor-driven	300
4—Small shears for rounds and bolts—motor-driven	450
5—Small hammer, shop made—air	100
6—Bolt cutter—motor-driven	780
7—Nut tapper—motor-driven	600
8—Spike straightener, shop made—air	100
9—Coil spring reclaiming plant	350
10—Re-babbitting journal bearing	250
11—Brakebeam repairing plant	400
12—General utility hammer—motor-driven	600
13—Acetylene cutter and welder	...
14—Washer machine—motor-driven	2,000
15—Iron reclaiming rolls—motor-driven	9,400

The committee has investigated these prices and knows that the amount shown will provide a suitable tool for the work.

Several hundred dollars per month can be saved by picking out good bearings and relining them. Many journal bearings can be reclaimed by the use of a cheap patented boring machine, which can be purchased for less than $200 and many roads are making good savings along these lines. While it is better to have a broaching machine with which to bore these out, large numbers can be relined with cheap facilities.

If brakebeam work is done at the plant, it is not necessary to transport beams to and from the shops, or have any extra handling of the scrap. A good furnace for heating and a plate for straightening is about all that is required. The work is such that good handy men can do a first-class job. No refitting is necessary as parts for each beam interchange.

Acetylene cutters and welders can be used for many purposes and, while a general plant is the best, cheap portable plants can make big savings in cutting up large trusses, etc., and in welding and building up many articles. Close attention must be given this work, as it is expensive and many roads are curtailing its use.

A good washer machine will save its cost in a few months. Cutting miscellaneous scrap and flues is severe work and a good strong machine should be secured, which can also make other specialties.

Iron reclaiming rolls are particularly desirable at this time on account of the high price of iron and poor delivery. Any road that has sufficient accumulation of scrap that will reroll should not be without one. Any shortage of iron that a reroll will handle can be quickly placed in stock. It is particularly desirable to have these rolls near the reclamation plant to save all extra handlings of both the scrap and the output.

The first twelve tools can be placed in the most temporary kind of building, built from scrap lumber and sheet and practically every tool will save its cost in from 30 to 60 days.

Brakebeam repair shops and reclaiming rolls require supervision to handle them, but there is no reason when the first nine tools are installed along with such work as repairing track jacks, drills, rehandling shovels, remounting hose, rebabbitting bearings, why an organization will not be sufficiently large to have proper supervision and inspection to efficiently handle brakebeam work and rerolling.

The following lists are given as a guide to show what is being done on different roads, and what can be done with only a small investment, as outlined in the list of tools:

Road A

Savings made by—	Average amount per month
1—Reclamation and sorting out car material	.....
2—Reclamation and sorting out mechanical department	$10,000.00
3—Reclamation and sorting out roadway material	450.00
4—Reclamation of bolts	800.00
5—Reclamation of nuts	400.00
6—Reclamation of shovels	50.00
7—Reclamation of springs	2,700.00
8—Reclamation of track spikes	Included in Road Material
9—Reclamation of bar iron	1,700.00
10—Reclamation of paper	.....
11—Reclamation of brakebeams	4,000.00
12—Reclamation of hose	.....
13—Reclamation of washers	100.00
	$20,200.00

Road B

1—Reclamation and sorting out car material	$ 6,913.08
2—Reclamation and sorting out mechanical department material.	2,328.66
3—Reclamation and sorting out roadway material	1,587.90
4—Reclamation of bolts	1,633.42
5—Reclamation of nuts	1,221.89
6—Reclamation of springs	577.49
7—Reclamation of bar iron	124.04
8—Reclamation of brakebeams	3,253.00
9—Reclamation of washers	17.64
10—Reclamation of wrot iron	3,717.32
11—Reclamation of hose fittings	3,130.02
12—Reclamation of waste	252.73
	$24,758.03

The committee has the necessary data regarding costs of tools and savings which can be made, in case any storekeeper or railroad is figuring on general reclamation work where a large or complete plant is desired.

These would be divided into three groups, as follows:

For Yard—Large alligator shears, magnet crane, casting drop, skips or buckets for handling scrap.

For Bolt Shops—Shears, bolt headers, bolt threaders, hammers, nut tappers, washer punch.

For Blacksmith Shop—Large power hammer, small power hammer, forges, bulldozers, spring tester, punch, emery wheels, power saw, rolling mill, furnaces, fans or blowers.

General—Magnetic separators, cinder washers, rebabbitting bearings, tin shop, hose room for mounting steam and air hose, stripping machinery, sewing machine for repairing sacks where used.

The inspection of material is a very important item and unless this inspection is carefully made, the statement from other departments that the work is inferior will have its effect. It is, therefore, especially desirable and necessary that all items reclaimed be inspected in the most thorough manner.

Many times complaints are made that reclaimed material is not satisfactory, and often the blame is placed where it does not belong, as the reclaimed articles may be picked out of some car or repaired at local points. It would appear desirable to have knuckles, coupler parts and similar articles dipped in some cheap asphaltum mixture so that if correct, these difficulties could be remedied; even though material is first class, it will be made use of much quicker if it looks like new.

Managements of railroads have been fooled so many times by figures that do not represent facts that it is necessary that the proper accounting be instituted that will bear the most rigid scrutiny, and if necessary call on the auditors to check the work so that they may know and you may be assured that your management respects the figures which are furnished as being accurate in every detail and that they cover overhead and all other charges and are real savings.

Cost of reclaiming, which includes all costs, is the governing factor and must include all costs of handling actual costs of reclamation, interest on investments, and the item must be satisfactory after being turned out.

It has been found to be a good thing to arrange visits of master mechanics, shop foremen and heads of departments to reclamation plants so that all may observe the loss of having material find its way to the scrap, also be of service in suggesting new ideas.

Reports showing the labor, overhead, total cost and comparison as authorized in last year's report should be made

each month so that the management will be aware of the savings being made.

The report is signed by D. D. Cain, chairman; R. K. Graham, J. C. Kirk, A. L. Tucker, H. G. Cook and W. J. Deihl.

COMMITTEE ON LUMBER

Inspection.—So far as the committee is able to learn, it is the general practice to inspect lumber at destination, there being but few exceptions to this rule, among which are the Union Pacific, which inspects oak at the point of loading; the Gulf, Colorado & Santa Fe, the Pennsylvania Railroad and the Illinois Central.

The inspection of lumber when received should be made strictly in accordance with the grade ordered; such grade having been adopted by the manufacturers' or dealers' association, governing grades in the territory where the stock is purchased; it being assumed that the railway in making the purchases selects the grade to fit its specifications. In cases of special specifications not conforming to the grades governing the territory in which the purchases are made, the inspection should be in accordance with the railroad company's specifications or special grade.

Disposition of Rejected Lumber.—The question of disposition of rejected material was discussed very thoroughly at last year's meeting and it is the committee's understanding that a majority of the members were favorable to declining all compromises with shippers, so far as accepting rejected material at a discount. It is found that on such roads as have adopted this plan, a marked improvement is manifest in the quality and grade of shipments received; there being a marked decrease in the number of rejects, as compared with the past.

Stacking Lumber.—There is a great variation in practice as between the different railroads; and a most decided difference in methods as between the railroad and commercial lumber yards, especially with respect to set rules as regards uniformity in foundations, stripping, height of piles, and their general appearance and grouping of dimensions in proper order. There are few railroads having ideal lumber yards, as in most cases the lumber storage must be arranged to fit local conditions, such as ground space available, track layout, convenience of delivery to shops, switching facilities, etc. The most important factors necessary to the ideal lumber yard are ground space and tracks. It would not be practicable for all roads to adopt the same practice, therefore, the committee recommends for consideration the practice as now in effect on the Gulf, Colorado & Santa Fe, quoted from a report from that road follows:

"All stacks should be from two to three feet above ground, to allow free circulation of air, and should be pitched, the front end higher than the rear end, on a pitch of one inch per lineal foot; thus in piles of 16 ft. lumber, the front end would be 16 in. higher than the rear end. Each piece should be exactly over the piece underneath it, and from 1 in. to 1½ in. apart from pieces on each side, for say 4-in. lumber, and increasing this space up to 3 or 4 in. in lumber up to 12 in. Crown pieces should be the same as the balance of the stack in lumber and timber, 1 to 4 in. thick. In timber 6 in. thick and over, this plan would run the stack too high, and 1 to 2 in. strips of waste lumber can be used. These cross pieces should be put on every layer and about 4 ft. apart and the front piece should project ⅛ to ¼ in. over the ends to protect the stack from sun and rain. Cut strips of waste lumber 2 in. by 2 in. and then saw these 2 in. square across from corner to corner and each piece will make two pieces that will be satisfactory, or saw pieces 1 in. by 2 in. by 2 in. by 2 in. When the stack is complete, take one piece the same as the balance of the stack and lay it flat on the space between each tier. Some saw mills put an air space 12 in. wide in the center of the stack, which they call a flue; others do not do this. Probably this is a matter that should be regulated by climatic conditions.

"Be sure that the center bearings of each stack are not lower than the end bearing. The lines should be straight to avoid sagging and the consequent accumulation and retention of dampness.

"Be sure that the cross pieces are exactly over each other, or crooked lumber will result. Do not use decayed or rotten lumber for cross pieces or foundations, as doing so will contaminate the good lumber."

Economical Ordering of Lumber.—It is recommended that storekeepers take up with the heads of the various departments having the making of requisitions the matter of specifying the exact widths or lengths in which lumber is to be applied. If this practice were followed out, it would result in a very material saving, as a great amount of lumber could be ordered in random widths and lengths, which can, as a rule, be purchased at a lower figure.

Saving by Re-Sorting and Substituting.—A representative of one of the large systems reports that the road which he represents has effected a considerable saving by re-sorting from lower grade lumber. One item amounted to $4,200 during the past year, in sorting V. G. and clear stock from common grades.

Saving Effected by Using Lower Grades.—On two of the systems represented on the committee, a considerable saving has resulted in the adoption of a lower grade of poplar. This grade has been found to be equally as good for the service as the higher grade stock. It was formerly the practice to use first and second clear yellow poplar. These systems are now using sap clears, which can be purchased at an average of $10 per thousand less than the grade formerly in use.

Re-Sawing.—A very large saving has been effected by re-sawing, the principal stock used in re-sawing being second-hand bridge lumber. The Burlington kept account of the operation of its machine and the saving effected has approximated $6,000 per year for the past three years. There is not only a saving in the sawing of the second-hand material, but also in the re-sawing of new lumber into odd dimensions, which are not ordinarily carried in stock. The re-sawing done by the Burlington has been principally in connection with lumber used in construction of buildings, stock yard trestles, etc.

Several points should be taken into consideration before locating a re-sawing plant. Perhaps the most important is the amount of available material that may be obtained from old bridges, buildings, etc. Such a mill should also be located as near as possible to the bridge and building material yard in order that the working force may be worked in conjunction with the force that handles the material. Storage tracks should be located convenient to the plant for unloading the material and piling it prior to shipment. The sawmill best adapted to this purpose is known as the "pony" type and can be purchased from a number of manufacturers for about $250. The saws should be 40 to 44 in. in diameter and have what is known as the inserted tooth. A 30 h.p. engine or motor will furnish the necessary power for such a mill providing the larger machines are not operated at the same time. The sawdust is used in ice houses and sent out to passenger stations for sweeping floors. The cost of handling and re-sawing timbers varies from $3 to $5 per thousand and much of it may be worth from three to five times that amount.

Manufacture of Tie Plugs.—Of the roads represented on the committee, the Burlington is the only one manufacturing tie plugs. It manufactures these at all of its principal plants. The machinery originally in use consisted of table gang saws. Material is made into slabs of the required thickness, double the length of the plug. These slabs are gained in the exact center at right angles to the length, then put through the saw and ripped in from four to six strips, producing eight to twelve plugs, according to the widths of the slabs. The plugs were separated by breaking at the gain, breaking at

that point shaping the point of the plug. This process was found not sufficiently rapid to produce the number of plugs required for the season's work. It therefore became necessary to devise different machinery, and the mechanical department constructed a machine by converting a boring and mortising machine for this purpose. This tool cuts and points the plug in one operation, and has a capacity of approximately 200 plugs per minute. The maximum production has thus far not exceeded 1,600,000 plugs per month, on account of lack of material. There are three of these machines in use at this time. The cost of the original machine, including converting and installing, was $226.

The material used in the manufacture of the plugs is mill waste, sawed into squares of the required dimensions and in lengths from 3 ft. up. The shorter waste is manufactured by the old style process—that is, the gang saw.

Reclaiming Material from Torn Down Cars.—The proposition of reclaiming lumber from torn down cars has not been taken up to any great extent, with the exception of four of the roads represented on the committee. The Burlington has gone into this matter to a greater extent than any of the roads represented. While it has no detailed figures to show the exact saving, by estimating a thousand feet to each car, multiplied by the number of cars torn down during the past year, the most conservative estimate suggests a saving of between $20,000 and $25,000. It must be understood that, of the lumber reclaimed, every foot displaces an equal amount of new material. Very much of the roofing goes back in repairs for the same purpose. It is also used for coal doors, sheathing under metal roofs, lining repairs, etc. The lining is also used for sheathing under metal roofs.

The reclaimed siding is used for original purposes; also for making of end doors, and repairs to side doors. All lining and roofing which is not fit for purposes previously mentioned is used in the manufacture of coal doors. Flooring is used for repairs in kind; also for decking for hand and rubble cars, sidewalks, platforms and coal door battens. The sills that are reasonably sound are used for sill splices.

The report is signed by James Garrett, chairman; J. F. Ritter, W. H. Clifton, W. S. Morehead, W. H. Thorn, A. L. Tucker, E. S. Newton, C. H. Schneider, F. B. Ashley and A. H. Young.

DISCUSSION

Certain questions pertaining to changes in specifications were recommended to the incoming committee on recommended practices. The committee also suggested the elimination of the first three paragraphs of the report on lumber. This suggestion was approved.

OTHER BUSINESS

Reports were also presented on Rail, Ties, Buildings and Structures, Stationery and the Handling of Company Material, and a paper by J. W. Gerber on Dismantling Cars is published in the Car Department section of this issue.

The following officers were elected: President, W. A. Summerhays, Illinois Central; first vice-president, H. S. Burr, Erie; second vice-president, E. J. Roth, Chicago, Indianapolis & Louisville; third vice-president, J. N. Shaw, Delaware, Lackawanna & Western; treasurer, J. P. Murphy, New York Central.

POWER HACK SAWS.—The first power hack saw machine was put on the market about twenty-five years ago. During the past few years the range and capacity of these machines have been greatly extended. They are furnished with quick return stroke, relief action for back stroke, means for using the full length of the blade, angle chucks and other improvements that have made this humble machine tool of high efficiency and low operating cost. Blades of great durability are furnished at low cost.—*A. S. M. E. Journal.*

DETENTIONS FROM A NEW ANGLE

BY F. E. SELLMAN

When at the end of a month, the various divisions on a railroad compare their locomotive failures, the usual practice is to give the number of failures, number of minutes detention, locomotive mileage, number of detentions per ten thousand locomotive-miles and number of minutes detention per ten thousand locomotive-miles. This is unquestionably a good comparison, but does it go into the subject deeply enough? From the motive power point of view it covers the ground fully; furthermore, that is what we have been used to—and no further questions have been asked. Let us consider if it covers the ground fully.

Why do we go to the expense of investigating the locomotive failures and tabulating the results? Of course, "to prevent recurrences," is the simple answer. Then why do we try to prevent locomotive failures? The traveling public would complain and soon a railroad would have a reputation for delayed trains that would take years of endeavor to correct.

The matter then assumes this aspect: We must not delay passengers. The number of passengers on a delayed train then becomes a factor; yet it does not appear in the reports of comparison. A through express train, carrying a large number of passengers, 300, for instance, is detained 20 minutes. This means that the passengers have altogether lost 6,000 passenger minutes. On the other hand, a local on a branch line carrying 30 passengers, loses 20 minutes, which would mean 600 passenger minutes. For the railroad's reputation and good name it matters a great deal whether there are 30 dissatisfied passengers or 300. Yet on the monthly reports of comparison each would appear as one failure of 20 minutes duration, while the fundamental factor has been overlooked, i.e., the number of passengers-minutes detention is the indicator of the service rendered.

For example: Two divisions, *A* and *B*, having the same mileage and the same locomotive mileage, have six detentions aggregating 95 minutes. These divisions would compare exactly alike from the motive power department's standpoint; yet from the traffic and operating department's point of view, division *B* excels in service division *A*, in that it detained less passengers per 10,000 locomotive-miles.

	Division A	Division B
Number of failures	6	6
Minutes detention	95	95
Locomotive mileage	106,000	106,000
Failures per 10,000 locomotive-miles	0.172	0.172
Minutes per 10,000 locomotive-miles	8.95	8.95
Passenger minutes per 10,000 locomotive-miles	1.235	923

SPEEDS AND FEEDS.—The important questions of speed and feed in connection with machining operations have, during recent years, been carefully studied by many superintendents and foremen who formerly relied entirely on the judgment of the workmen, which was sometimes good and sometimes bad. Speeds and feeds are fixed in the planning department and are based on the power of the machine and character of the metal.—*A. S. M. E. Journal.*

ACCIDENT PREVENTION.—The prevention of industrial accidents has received wide attention in industrial establishments. In machine shops accident prevention is a relatively simple matter, but there are a few points of danger which have become generally appreciated, and all of the better types of machines are equipped with guards to cover gearings, setscrews, flywheels and all moving parts not necessarily exposed. There are also certain sources of danger which exist in practically all manufacturing plants and the general rules to prevent accidents from slipping ladders, piles of castings, elevators, etc., are being applied.—*A. S. M. E. Journal.*

Car Department

TERMINAL CLEANING OF PASSENGER CARS*

BY J. E. ROSS
Master Painter, New Orleans, Mobile & Chicago, Mobile, Ala.

Terminal cleaning of passenger cars is an operation of primary importance and a problem involving the attainment of maximum results in a limited time for the least expense, time being as important a consideration perhaps as any other factor. Cleaning of any kind is ineffectual if not done thoroughly, and a delusion in the matter of cost if the work is in any way injurious to the article cleaned. Thus the need is emphasized of a system based on thoroughness and backed by a knowledge of what is best for the articles to be cleaned.

The term "terminal cleaning," while conveying the impression of one operation, actually covers three; one of these, really more important to patrons than mere tidiness, is sanitation; the other operation and to the railroad company itself a most important one, is the preservation of the mediums used to preserve and beautify the interiors and exteriors of passenger cars. Thus we have three operations, cleaning, sanitation and preservation.

Efficiency in this important work is governed entirely by three factors, interlocking and indispensible one to the other: First: A suitable location and suitable equipment; Second, Organization; Third, a director who understands the nature of the surfaces to be cleaned and having some knowledge of hygiene and sanitation.

The cleaning yard should be located in an open space of suitable area connecting with or adjoining the storage yard for passenger cars easily accessible and having a hard level floor, preferably of screened cinders, with sufficient drainage to take care of storm water quickly. All tracks should be of sufficient capacity to accommodate trains of ordinary length. Each track should be served with water and compressed air openings sufficient to space two to a car, these openings to be located between the tracks and in receptacles below the freezing lines and fitted with suitable covers when not in use. Steam pressure connections should also be provided, and so located that all cars in the cleaning and storage yard can be heated when necessary to prevent freezing or when being made ready for service.

For the cleaning of seat cushions, carpets, aisle strips, etc., a rack should be provided, made in sections so as to be easily moved from place to place if necessary. In localities where severe weather conditions obtain for long periods, a suitable shed should be provided located at the most accessible point in order to perform this work without loss of time or increased cost. Granted these facilities, we will now proceed with the various operations and methods of actual cleaning.

To a greater or lesser extent there will be found a miscellaneous assortment of discarded newspapers, candy boxes, chewing gum wrappers, fruit pealings and what not, strewn about the car interiors and whether the loose dust and cinders are removed with a compressed air nozzle or by the vacuum method, this litter must be removed first. This is done by a man going through the train and gathering it up in a suitable receptacle. All removable equipment should now be taken out, such as cuspidors, aisle strips, seat cushions and water coolers (if these are removable), all equipment being checked as removed and anything missing or in bad order reported. This leaves the interior practically stripped and ready for the air or suction cleaner. The writer favors the former as being quicker and it can be made as effective as the suction method by using a six-inch nozzle made of brass with an opening not over 1/16 in., as this furnishes sufficient volume without waste of pressure. A nozzle of the same design, but 12 in. wide, is used for carpets and aisle strips. The nozzle is passed over and around steam heat pipes, behind fender guards and around seat frames, the operator passing it over the plush seat backs with a firm pressure against the pile of the plush, around and behind window fixtures, pulling down each curtain and working both sides of the aisle and toward one end of the car. All windows should be open during this operation to allow the dust to escape. In performing this work the operator should be protected by a respirator made from a piece of sponge of close texture dampened and fastened over the mouth and nostrils, and a long dust coat buttoned up closely.

The window glass should now be cleaned. This is best done by rubbing the glass quickly with a small sponge or piece of waste dampened and dipped in powdered Tripoli; when nearly dry the glass is polished off with clean, dry waste. Parts of the glass not accessible to the hand on account of sash overlapping can be reached with a small mop having a thin flexible handle of hardwood and a cloth wrapped around the end.

This leaves the general car interior ready for wiping down which should be done with clean cotton waste of fine texture and long fibre, ¼ lb. per car being sufficient for all wiping of interior and exterior, including the trucks. This waste should be impregnated with a non-drying oil, neutral and preferably of vegetable origin, by immersing the hands in the oil and wiping them with the waste, repeating as often as necessary until the waste is sufficiently impregnated to catch all the dust without leaving the surface noticeably greasy. In blowing out and wiping down it is not always necessary to remove seat cushions or to wipe headlinings, although in the case of the latter if gas or oil is used for lighting it must be done frequently to prevent accumulation of smoke grease, both objectionable in appearance and destructive to the finish. It will be found that varnished or enameled surfaces treated in this manner are free from all dust particles and will present a revived and fresh appearance, the life of the varnish being prolonged and the dual service of cleaning and preserving being carried out.

The floor is now mopped with a deodorizer-disinfectant solution, hoppers and urinals having been cleaned and disinfected in the meantime, which leaves the car interior clean and sanitary, the appearance being governed largely by the general condition of the interior finish.

Water coolers, cuspidors, hoppers and urinals in the meantime are receiving the attention necessary to secure cleanliness and sanitation. After removing the cuspidors from the car, the operator takes them to a large sink with trapped sewer connection, and dumps them into a metal receptacle having a perforated bottom so as to allow all

*Awarded the Second Prize in the Car Terminal Competition.

liquid to waste off and hold the solids, which are later removed; they are then mopped out with a strong potash or alkali solution containing an abrasive, rinsed with a hose and after being replaced, a small quantity of a deodorizer-disinfectant solution is poured into them. The same operator cleans and disinfects the hoppers and urinals, using much the same methods and materials as used in cleaning the cuspidors.

All passenger cars for the cleaning of which the writer is responsible, are equipped with removable water coolers of a standard and interchangeable design. After being removed from the car they are emptied and examined and if in good order are taken to a steam pipe having an open pipe connection in a horizontal position and fitted with a globe valve. The cooler is hung on the pipe, which is long enough to support it, and a strong pressure of live steam is turned in and maintained about half a minute. This thoroughly cleans and sterilizes the cooler and insures sanitation. The coolers are then ready to be replaced, filled and iced, tongs being used to handle the ice. If a hose is used for filling, care should be exercised not to allow water which has stood in the hose for any length of time to enter the drinking water containers, especially if exposed to the sun, as it invariably gives the water a bad taste. Complaints are frequently made of bad water and in many instances they are traceable to improper cleaning of the containers or carelessness in filling. If the drinking water containers are stationary they should be emptied and flushed out thoroughly.

The aisle strips or carpet having been cleaned in the meantime should now be replaced, completing the interior and bringing our attention to the outside of the car body.

The same waste used to wipe the interior is again treated with oil renovator and used on the outside, wiping being superior to washing as a regular cleaning method, inasmuch as while removing dust and in a measure preserving the varnish it also tends to remove dead or oxidized varnish film from the surface.

There are two ways of reaching the upper parts of the car, both practical. One is by the aid of the old style coach ladder fended off from the car surface with a box-like fender at the top having the contact face covered with a padded cushion. The other is by the use of a portable scaffold or bench ten or twelve feet long, with two low wheels attached to the legs at one end and two handles formed by the braces projecting at the other end. It is constructed of the proper height to permit an ordinary sized man to reach the letter board and has one step brace below the platform to enable the operator to attend to the windows and window stretch without stooping. The advantage of this bench over the ladder is obvious as the operator can cover a long stretch, properly cleaning the windows at the same time without getting up and down so often. It also saves time and effort in moving the ladder. The bottom stretch is treated the same as the top which completes the car body.

If the train arrives in the cleaning yard during a rain storm or with the outside of the car bodies wet, the use of the car washer brush will be necessary. This should be either of the fountain variety or in connection with a water supply from a hose, and during periods of low temperature and bad weather conditions, outside cleaning may have to be omitted altogether. Cars just out of the shop should be flushed down with a gentle stream of water, a good long bristle washer being used to start all dust that will not move otherwise. This cleans a freshly varnished car without marking or scratching the varnish, and assists in hardening it.

The trucks are often neglected and seldom receive the attention they deserve. The condition of the main surfaces should determine the cleaning treatment. If the surfaces are rough and broken and otherwise in bad condition it is obviously a waste of time to try to wipe them. A quick treatment with the hose assisted by an old car washer brush is usually sufficient for trucks in this condition and as good as any, but if the surfaces are bright and reasonably smooth a quick treatment with the air nozzle, followed by hand wiping, gives good results quickly. Still another method is to spray the trucks with a mixture of water and oil, which is done by spraying from a reservoir having two compartments, one filled with oil and the other with water and having two nozzles spraying simultaneously. The mixing takes place at the nozzles. This should be followed by a quick application of the air nozzle which dissipates and evaporates the water and leaves a fine film of oil, thus cleaning and preserving the enamel besides improving the appearance wonderfully at little expenditure of time and effort. This should complete the terminal cleaning, and by proper organization can be done at a very low cost per car.

On railroads where the shopping periods for passenger cars varies from 18 months to 2 years and longer, this treatment will not be sufficient, and at intervals of not more than six months the cars should be taken out of service and thoroughly cleaned. This should include washing down and renovating of interiors and the cleaning of the exteriors with a neutral oil emulsion cleaner. If the cleaner is followed by the application and rubbing off of a good renovator, surprising results can be obtained, but this is optional as the car should look well without this. At this time a little touching up here and there on irons, pipes, etc., more than compensates for the time and material used in improved appearance. Acids and alkali solutions and emulsions are best avoided in terminal cleaning, as they are at best dangerous, and while they clean they also destroy to a greater or lesser extent, depending on the operator and how they are used.

HOW TO KEEP CAR INSPECTORS

BY A. C. SHINAVER

Judging from the different articles published in the *Railway Mechanical Engineer,* there seem to be ideas on how to make good car inspectors but no clear or defined idea on how to *keep* them. My opinion, and I think the opinion of many others that have worked as car inspectors or around freight or passenger cars, is that if the following suggestions were tried there would be less trouble in securing and retaining a sufficient number of reliable inspectors:

Let the head of the car department look into the actual conditions under which their inspectors have to work in the different yards. I have found in my experience that no two yards are handled alike.

Have a sufficient number of the proper kind of tools.

Have one person who will give the inspectors *all* instructions, instead of half a dozen or more telling them what to do.

Show appreciation when good work is done. When an inspector makes a mistake do not say, "Why didn't you do it *this* way?"; but caution him to be more careful in the future.

Have a school for inspectors and give them instructions in the interchange, safety appliance and loading rules. Have the men get together and be more sociable.

Shorten the working hours and make three shifts in the 24 hours and pay better wages. It would be impossible to work for any less than inspectors are getting now and live. It is well known that the inspectors are not getting paid in proportion to what men get in the other departments, considering what they have to learn.

Cooling Lubricants.—An improvement in shop practice worthy of mention is the more generous use of cooling mediums on cutting tools, and the provision of distribution systems for both the tools and the bearings supplied from a central reservoir.—*A. S. M. E. Journal.*

AIR BRAKE ASSOCIATION CONVENTION

Discussions on Slack in Long Passenger Trains, Air Brake Apprentices, Freight Brake Maintenance, Etc.

The Air Brake Association at Atlanta, Ga.

THE twenty-third annual convention of the Air Brake Association was held in the Ansley Hotel, Atlanta, Ga., May 2-5, 1916, J. T. Slattery, superintendent of the Denver & Rio Grande presiding. The convention was welcomed to the city by J. G. Woodward, the mayor of Atlanta.

PRESIDENT'S ADDRESS

The president called particular attention to the need of better air brake maintenance. He believed that railway officers were taking more interest in air brake questions but it seems that the money to be spent for maintenance of air brakes is still grudgingly given. The importance of the air brake in safely conducting the transportation business would seem to warrant a more liberal expenditure of money for its maintenance. The eastern roads should give more attention to the retaining valve pipe and associated parts. Usually these parts, which are of no service to the eastern roads, are neglected, and when the car arrives on the western mountainous road, repairs must be made before it is fit for grade work, causing serious delay to traffic.

SLACK ACTION IN LONG PASSENGER TRAINS

Troubles incident to operating long passenger trains have increased in the past few years, notwithstanding the consideration that the subject of passenger train handling has been given by the air brake men and others. Slack action in any train is produced only by a change in speed between the various cars comprising such trains. The degree or severity of such slack action depends on the rate at which the change in speed takes place, and the weight and number of cars involved.

Brake cylinder pressure must rise gradually in order that the movement in the train wil be taken care of gradually, unless the speed be very high. Under the present order of general passenger brake conditions, this must be brought about by the brake pipe reduction being made in light steps and an increase in the time of making stops. The amount of the initial and succeeding brake pipe reductions, producing brake applications, must therefore be made in proportion to the speed of the train and the number of cars involved. It is necessary to maintain a brake cylinder volume equal to 8 in. piston travel on cars, if it is desired to obtain proper brake cylinder pressure, and at the proper rate that the operating mechanism was designed for. Piston travel shorter than 8 in. produces a higher cylinder pressure for any given brake pipe reduction than should be the case; therefore this reduces the time in which the cylinder pressure can be built up, causing the cars to stop more suddenly than desired. It is the opinion of the committee that some means will have to be provided to offset the bad effects of heavy cars and single shoe type of foundation brake gear. The automatic slack adjuster cannot be eliminated, since it is impractical to attempt manual adjustment of piston travel on passenger cars generally, on account of wide variations in the matter of time, difference between standing and running travel, the inability to determine these differences and the liability of excessive travel.

Therefore it can be seen that although a train may be equipped throughout with PM or LN equipment, many faults exist in which the type of triple valve has no bearing. The manner in which experience has demonstrated the responsibility of the triple valve in relation to slack action in passenger trains, is that in connection with mixed PM and LN equipments, where the graduated release of the L triple valves are being used in connection with cars in the same train equipped with P triple valves. The L triple valve, if a reduction of brake pipe pressure is made after a partial release, develops a higher brake cylinder pressure in proportion to the brake pipe reduction than is the case with the P triple valves. This feature of the L valve produces a high rate of brake cylinder pressure increase which may produce slack action in trains.

There are four causes contributing to poor train handling, but no attempt will be made to cover them more than fully encugh for those broadly informed on the subject to follow cause and effect.

Weight of Vehicle.—This necessarily involves magnitude of braking forces, which in turn means large brake cylinders, which require: Large air volumes; large air valves, and heavy foundation brake gear.

Length of Trains.—This introduces a serious element into brake operation and performance, namely, that of time, particularly that of difference in time between brake application on the vehicles at the front of the train and those at the rear, permitting retardation to commence at the front of the train long before it commences at the rear, thus bunching the train and producing a reaction when an equivalent re-

tardation from brake action ultimately takes place at the rear.

Foundation Brake Gear.—On account of the heavy forces and consequent severe duties imposed on the foundation brake gear, the designs generally used have become entirely inadequate as far as efficiency in permitting the air brake itself to perform its functions in proper proportion and the smooth handling of trains are concerned. The faults in the present foundation brake gear are principally in the spring suspension of hangers, the shoes being hung very low on the wheel, and the use of the "single shoe" type of gear. This design and type of foundation brake gear necessarily involves the condition of very short piston travel, which even with very light reductions results in a complete annulment of the proportions of the air brake proper, which results in very heavy braking forces, even when the lightest is necessary to avoid shock. In the endeavor to avoid this shock on the part of the engineer by making very light reductions, so little differential in pressure is produced between brake pipe and auxiliary reservoir that some of the brakes will fail to release with the consequent loss of power, inability to make schedule time, increase in fuel consumption, burning up of brake shoes and heads, and flat wheels.

Air Brake Valve Mechanism Itself.—When length and weight of trains was much less than at present (remember that many cars in trains of today now require two complete brakes per car) the attainment of a comparatively great and rapid differential or change of pressure was easily secured, but under present conditions this necessary condition is not possible with the equipment as now used.

This report has dealt only with the fundamental causes of the bad effects, and the remedies suggested strike at the root of the evil. It may be presumed, however, that the bad effects may be mitigated in a practical manner by instruction, maintenance and manipulation.

The report is signed by J. A. Burke, chairman, and W. Hotzfield.

J. T. Slattery, President, Air Brake Association

DISCUSSION

The foundation gear on many of the modern heavy cars was believed to be of improper design. Those roads that are using the clasp brake do not have nearly the amount of trouble that is experienced by those roads using the single shoe brake. The violent shocks in passenger trains which are many times sufficient to break a passenger train in two are the direct result of uneven piston travel in the cars throughout the train. This is due to an efficient foundation gear and poor brake cylinder maintenance. It was stated that the locomotive engineer could not be held responsible for poor handling of the train when such conditions exist. With the single shoe type of gear the shoes are hung below the horizontal center line of the wheels and as they are pulled down by the friction of the wheel, in heavy brake applications, the automatic slack adjuster compensates for this additional horizontal movement of the shoes and thereby shortens the piston travel which gives unequal braking. For this reason the clasp type of brake was strongly recommended. With this type the shoes are hung on the horizontal center line of the wheels and the pressure of each individual shoe on the wheel may be reduced. The forces acting on the truck are also such as to tend to keep the shoes in their proper position. With conditions such as they are at the present time it is believed necessary to take longer time in stopping the long passenger trains than is necessary in stopping the short trains by a more gradual application of the brakes. The subject was continued for the purpose of investigating means for overcoming the difficulties now met in train operation with the present air brake systems.

MAINTENANCE OF FREIGHT BRAKES

To maintain higher efficiency of freight brakes, regular and systematic inspection and repairs are necessary. There are no doubt thousands of brakes practically useless which reach the next cleaning date without their condition becoming known. Recent dates of cleaning, shown by stencils on many defective brakes found, indicate poor work done by cleaners. Brake cleaners cannot be criticized where adequate means for testing are not provided or where the men are not properly instructed in making brake tests and repairs or are not allowed sufficient time to do the work well. The error is often committed, in connection with air brake work, of requiring quantity and neglecting quality.

In 25 trains tested on account of complaints that they were hard to hold on heavy grades, it was shown by thermal tests made at the foot of a grade that from 10 to 26 brakes in each train were of no use. The test before leaving the summit consisted in a 20 lb. reduction being made and all brakes were considered good that remained applied while an inspection was being made (about 14 minutes). This indicated 28 to 49 tons per brake, while the thermal tests made after descending the grade showed 36 to 74 tons per good brake. The number of cars in these trains ran from 56 to 70 and the gross tonnage from 1,940 to 2,850 tons per train.

As an indication that the condition of freight brakes showing the need of more efficient cleaning and repairing is found throughout quite an extensive territory, we will give a few figures covering brake conditions on cars passing over a group of roads which maintain "deadlines" to protect their mountain grade traffic. One tabulation shows that out of 19,862 freight brakes, representing many different lines of railroad, that were tested during the last eight months of 1914, parts required repairs as follows:

Triple valves	2,268
Brake cylinder packing leathers	2,295
Pressure retaining valves and their pipes	3,080

By another tabulation made at "deadline" points covering 40,367 brakes tested during eleven months in the latter part of 1913 and the forepart of 1914, the parts shown to be defective were as follows:

Triple valves	5,386
Brake cylinder packing leathers	8,369
Brake cylinders cleaned, including those having packing leathers defective	17,813
Pressure retaining valves	10,046

The following tabulation covering triple valves removed and sent to repair shops when defects were indicated by yard and cleaners' tests and in cases of slid flat wheels, will give an idea of the kind of defects found in triple valves and the extent to which they exist.

15,270 triple valves removed for all causes.
8,638—56 per cent—Packing ring leaking.
5,444—36 per cent—Slide valve leaking.
1,871—12 per cent—Graduation valve leaking.
1,348— 9 per cent—Piston bushing worn.

1,244— 8 per cent—Emergency valve defective
156— 1 per cent—Feed groove defective.
274— 2 per cent—Vent valve defective.
350— 2.2 per cent—Vent valve piston.
196— 1 per cent—Water in triple.

The foregoing figures would indicate the necessity for more and better triple valve repairs and, in addition to this, the committee emphasizes the need of systematic and continued attention to brake cylinder leakage. It is indicated by careful tests made that approximately 50 per cent of freight brake inefficiency is due to brake cylinder leakage.

T. W. Dow, 1st Vice-Pres. Air Brake Association

A large part of these brakes are considered efficient by level roads. This involves a number of details, such as packing leathers in poor condition on account of being porous, due to not being treated at regular intervals with a proper filling substance, worn thin or cracked, not being centrally applied on the piston, follower plate bolts not drawn tight, expander ring of poor quality of metal and lacking elasticity, failure to shape the expander ring to fit the cylinder and follower plates of too small diameter to prevent the expander ring slipping out of place.

As showing the effect of service, a gage test of 76 brakes that had run less than the allotted time since cleaning showed, after obtaining 50 lb. brake cylinder pressure and noting loss during one minute:

71.0 per cent leaked over 5 lb.
59.2 per cent leaked over 10 lb.
40.7 per cent leaked over 15 lb.
21.0 per cent leaked over 20 lb.

The 59.2 per cent that leaked over 10 lb. averaged 22 lb. leakage per minute, or 44 per cent of a full service application. Yet, all of these are brakes that would be termed "Efficient" in an ordinary terminal test.

A thorough instruction trip, during which work done by cleaners and repair men was carefully checked and advice given as to how to locate and remedy defects, produced a betterment in the following year of 7.5 per cent in the average months of service before cleaning was required.

The report was signed by: Mark Purcell (chairman), J. T. Slattery, and Frederick VonBergen.

DISCUSSION

The importance of maintaining the brake cylinder in good condition was greatly emphasized. Trouble has been experienced with the cylinder packing leathers becoming porous. Some roads are attempting to reclaim them by soaking them in a suitable "filler."

F. B. Farmer, Westinghouse Air Brake Company, referred to the brake cylinder as one of the most important and vital parts of the air brake system. Its cleaning, lubrication and repair are almost entirely placed in the hands of the lowest paid air brake man, and too often the quantity handled by this man is the sole measure of his work. The properly maintained triple valve must accompany the properly maintained brake cylinder. With the latter and without the former the brakes will creep on, resulting in stuck brakes and slid-flat wheels. The soap-suds leakage test on the brake cylinder piston rods is a simple, quick and reliable test which none should neglect to use.

On the Northern Pacific a brake cylinder is set up at repair points to enable the men working on air brake repairs to test out packing leathers and learn to distinguish between the good and bad ones. In the closing Mr. Purcell stated that a great deal of inefficient work is due to the lack of proper instruction or education of the man that is assigned to do this class of work. It is possible to maintain an air leakage of less than five pounds per minute by proper organization and competent workmen. The lubricant used in an air brake cylinder should be such as would penetrate into the packing leather serving as a filler.

AIR BRAKE APPRENTICES

BY C. M. DRENNEN

Few, if any, railroads have made any effort, until recently, to produce specially trained men to take care of the air brakes. Air brake mechanics are generally selected in locomotive service from machinists or in car service from car repairers or helpers. According to the schedules of most railways, machinist apprentices are given their choice of two or three months in either "the tool room, air room, or brass corner." This is usually the experience that a greater part of the air brake mechanics have during their apprenticeship. They are, therefore, not equipped to take the responsibility of air brake work in the roundhouse or shop, but must get their training by experience after becoming machinists. This is expensive, not only because of the pay the machinist draws but also because of the mistakes he will make and, therefore, the delays he will cause while he is getting this experience.

One railroad is training machinist apprentices for air brake work by giving them their last six months on air brake work with the two or three months they had in the air brake repair room. This will give them eight or nine months of practical experience. This road gives all machinist apprentices air brake class room instruction once a week for four to six months of the year. Classes are held at night in a room especially equipped and attendance is made compulsory. The boys are started in these classes not later than the time they begin work in the air brake room. Another road gives six months in the air brake repair room, six months in roundhouse air brake running repairs and turns the technical training over to the International Correspondence School. An efficient air brake mechanic is one having such practical experience and working knowledge of air brakes that he can inspect, repair, set up and test properly the equipment in his charge in the least possible time.

C. H. Weaver, 2nd Vice-Pres. Air Brake Association

Following are the proposed schedules for specializing apprentices on air brake work. In the first one the boy would be selected from the machinist apprentices as they go through the air brake repair room. They will have served two and a half years as machinist apprentices, and when they get in the air brake work, if they show themselves especially adapted for this work, they may be made air brake apprentices and given the following schedule with which to finish their time as such:

	Months.
Air brake repair room in general shops	8
Lubricators, injectors, and headlights	3
Air brake pipe work	1
Roundhouse air brake repairs, inspecting, etc.	5
With road foreman of engines, air brake instruction car, or firing	1
Total	18

The schedules following will give an air brake apprenticeship from the start. The usual method of selecting apprentices would be followed; that is, from boys in the shop or applications. They should be given six months as others are, and if not fitted for the work could be transferred or dismissed:

	Months.
Repairing hose, angle and cutout cocks, retainers, etc.	3
Cleaning and repairing triple valves	6
Dress press and lathe work	3
Repairing pumps	3
Repairing brake valves and engine equipment	4
Lubricators, injectors, headlights	2
Air brake pipe work	2
Rip-track air brake work.	1
Inspecting trains (helper).	1
Roundhouse air brake works	9
With road foreman of engines, air brake instruction car and firing	1
Total	36

F. M. Nellis, Sec.
Air Brake Association

It may be said that there is not enough demand for air brake mechanics to afford a place for such an apprenticeship. Yet, if the number of men who are employed on railroads in the service of tinner, blacksmith, painter, upholsterer, patternmaker, molder, etc., for all of which an apprenticeship course is furnished, is compared with the number of men working on air brakes, lubricators, and injectors, it will be found that the latter will exceed any one and most any two of the former classes. The air brake is fully as important, requires as much skill, and certainly more time should be spent in learning how to take care of it.

A schedule for air brake apprentices for car work is given below:

	Months
Dismantling air brake equipment	1
Repairing hose, angle cocks, etc.	2
General rip-track and air brake repair work	10
Cleaning and repairing triple valves	4
On brake cylinders	2
Leverage work	1
Testing	1
Inspecting trains	8
Braking on road	1
Total	30

This would make a trade out of air brake repairing and inspecting and would secure better men in the service; it would produce men that would be valuable assets to the car department. The efficient air brake mechanic will keep down failures, keep engines and cars moving, and add much to the life of air brake equipment. The value cannot be estimated, nor can the railroad determine the exact results from such an expenditure, but it will be repaid many times for the efficiency added to these departments.

DISCUSSION

It was stated that the importance of having an adequate and thorough apprentice system for the instruction of the men that maintain the air brakes has been greatly underestimated in the past. It is necessary for these men to thoroughly understand the purpose for which the various parts of the air brake equipment are used in order that they may know of the importance of their work in train operation. There is no question but that a lot of work is done inefficiently, and that delays and accidents occur because the men handling the air brake repairs are not properly informed. It was believed that this subject was a most important matter for the railroads to consider.

CARE OF MODERN PASSENGER BRAKE EQUIPMENT

BY C. U. JOY

The subject of the care of modern passenger brake equipment naturally divides itself into three parts, namely: Inspection, yard testing, and maintenance.

Inspection.—Car inspectors, repairmen and air brake inspectors should be instructed and required to pass an examination on the construction and operation of the air brake equipment in order to qualify them properly to perform their duties. Trains should be properly inspected on arrival at terminals. Local trains should be given a terminal inspection once each day. The automatic slack adjuster is an essential part of a modern passenger brake equipment, and must be attached to each brake cylinder.

Yard Testing.—Every passenger train, after having had its terminal inspection, should be subjected to a proper yard test. The yards should be properly piped and have compressor capacity sufficient to maintain at least 110 lb. air pressure. There should be a portable testing machine with suitable walks between the tracks to facilitate moving it about. A terminal yard handling 16 trains, averaging 8 cars each per day, should have one testing machine and two men to make the tests.

Maintenance.—The subject of maintenance may, for convenience in handling, be divided into three parts: Valvular mechanism; parts connected with air, such as piping, brake cylinders and slack adjusters, and the mechanical transmission, such as levers, rods, brake shoes, etc.

It has been the practice of practically all railroads to clean the triple valve every three months and the brake cylinder and slack adjuster every six months. Tests have developed that a PC control valve properly cleaned and lubricated and afforded proper protection from dirt and moisture will remain in service over a year and stand the yard test each day, and also that this same valve will pass the rack test. Such being the case it is reasonable to assume that the efficiency of the valve is increased above what it would be if it were cleaned four times during the year or every three months. The control valves that were subjected to this test were lubricated as follows: The slide valves, piston bushings and packing rings were lubricated, sparingly, with dynamo oil, graphite and oil, triple valve oil and a light generator oil.

Otto Best, Treas.
Air Brake Association

The cost of removing, cleaning, testing and replacing a control valve is, together with the dust collector and strainer, about $1.53. All valvular mechanism that fails to pass the yard test should be removed and shopped for repairs.

All piping should be thoroughly inspected and tested. Tests have determined that if brake cylinders are properly cleaned and lubricated, particularly if they are equipped with the J. M. expander ring, they will remain in service with a minimum leakage for 18 months. The cost of cleaning and lubricating the brake cylinders and slack adjusters is about $1.02, which, added to $1.53 for the control valve.

gives a total cost for cleaning the entire equipment of $2.55, the average price of labor being 25½ cents per hour. Extending the time of cleaning of the control valve to six months and the brake cylinder and slack adjuster to 12 months would mean a saving of 50 per cent of the present cost of this work, and experience will probably demonstrate that a further saving may advantageously be made along these lines.

Levers and rods should be carefully inspected. The construction of the foundation brake gear should be such as to maintain the position of the brake shoe in relation to the wheel at the same point practically all the time, giving uniform braking and an even wear of the shoes.

With the heavy passenger equipment now in use a properly designed clasp brake is of the utmost importance for efficient and satisfactory braking. The advantage derived by using the clasp brake is very noticeable in service, as it does away with the pulling-down effect on the truck during a brake application, making a much smoother stop. Hot boxes are eliminated to a certain extent due to an equal pressure being exerted on each side of the wheel which holds the journal in its bearing and the tendency of picking up waste between the journal and bearing is remote. Tests have shown that with this type of brake the life of the brake shoes is approximately 30 per cent greater, due to the low brake shoe pressure.

DISCUSSION

It was generally believed that the time of cleaning triple valves, control valves and brake cylinders on passenger equipment could be increased from three to six months provided the work was thoroughly done by competent men. This does not mean, however, that they should not be tested. One member believed that it would be practicable to allow these parts of the air brake equipment to go without cleaning until they were shown defective by the M. C. B. tests. This would materially reduce the cost of the air brake maintenance. Some members advocated that no oil be used on a triple valve slide valve seat. Oil is a cause of undesired quick action and will catch dust and cause the valve to become dirty. Tests made on the Central of New Jersey with 1,000 new cars, on 500 of which the triple valves were lubricated with graphite and the other 500 having no lubrication at all, showed at the end of the year that those with no lubrication had given the better service and were in better condition.

MOISTURE IN LOCOMOTIVE BRAKE SYSTEM

BY MARK PURCELL

It is absolutely necessary thoroughly to thaw and blow out the main reservoirs and piping each trip before the engines leave the roundhouse. Where this practice has been followed, freezing of the pipes in severe cold weather has been eliminated, and where this has not been done the freezing has been frequent.

Temperature tests of the air were made on a locomotive having an 8½-in. cross compound compressor located on the left side, and well forward, two main reservoirs—one on each side under the running boards and well forward of firebox—with a combined capacity of 75,000 cu. in., 45 ft. of 1½-in. discharge pipe between the compressor and the first main reservoir located under running board on left side of engine and 50 ft. of 1-in. equalizing pipe between the first and second reservoirs running from the forward end of the first main reservoir on the left side, under boiler to the right side, then forward and back under the running board connecting to the forward end of the main reservoir on the right side of the engine, a 1-in. pipe extending from the back end of the second main reservoir to the engineer's brake valve. Thermometers were inserted in the piping at different points as follows: No. 1 at the point of connection of the compressor discharge pipe to the first main reservoir; No. 2 at the connection of the 1-in. equalizing pipe to the second main reservoir, and No. 3 in the 1-in. pipe between the second main reservoir and the engineer's brake valve. Other thermometers were used to determine the prevailing temperature of the air before it entered the compressor. The locomotive was standing still during the tests and there was a slight wind blowing against the right side of the engine.

The compressor was started and when the pressure had been raised from atmospheric to 90 lb., as shown by the air gages, thermometer No. 1 showed 80 deg.; No. 2, 41 deg., and No. 3, 44 deg. The engineer's brake valve was then placed in full release and the rear angle cock opened sufficiently to relieve the pressure, and the compressor was run for 2 hours and 45 minutes with results shown in the following table:

No. of Run	Time run—min.	Speed single strokes per min.	Temperature degrees—F.					Air pressure pounds
			Atmos.*	At strainers†	Ther. No. 1	Ther. No. 2	Ther. No. 3	
1	27	128	40	60	121	61	63	90
2	25	108	40	60	116	56	62	90
3	15	120	40	60	136	66	60	88
4	25	120	45	63	146	81	68	85
5	20	122	45	63	146	83	63	90
6	28	80	45	60	106	61	60	90
7	25	80	45	58	106	60	60	90

*Thermometer was located 15 ft. from the engine on the right side.
†Thermometer was located 10 in. from the strainer of the compressor.

As shown in the table, thermometer No. 3 showed a slightly higher temperature than thermometer No. 2 in the first and second runs and lower in the subsequent runs. This was due to the effects of heat from the firebox and variation in the speed of the prevailing wind. The difference in temperature of the surrounding atmosphere and that at the compressor air strainers indicates the necessity of locating strainers in the coolest place possible. Conditions observed generally as well as the temperatures shown by the tests would indicate that the proper amount of cooling pipe needed has not been reached in any of the locomotive installations yet recorded.

There should be at least two main reservoirs on each locomotive with 50,000 to 90,000 cu. in. total storage volume, corresponding to compressor capacity, and preferably not less than 60,000 cu. in. for freight locomotives, with 45 ft. of discharge pipe between each compressor and the first main reservoir, and from 50 to 60 ft. of equalizing pipe between reservoirs. One inch pipe is preferable to any larger size for the equalizing pipe between reservoirs on account of it giving a greater amount of radiatiton per cu. ft. of air passing through it and providing sufficiently rapid flow to fill the requirements when releasing the brakes. Air cooling pipes should be located above the point of connection to the reservoirs so that moisture may drain into the reservoirs with the flow of air.

DISCUSSION

It was stated that it was impossible to lay down a hard and fast rule governing the length of radiating pipe between the air compressor and the main reservoir. The length of radiating pipes depends upon the size of the compressor. Mr. Park, of the Westinghouse Air Brake Company, stated that ½ sq. ft. of radiating surface is allowed per cu. ft. displacement of the compressor in communities where it is neither too warm nor too cold. The pipe passing from one side of the engine to the other is not included with the radiating surface, as it is too near the boiler. Also the surface of the reservoir is not included in computing the radiating surface. The air strainer to the pump can, with considerable advantage, be piped out from the pump to permit of getting as cool and dry air as possible.

Mr. Purcell stated that on the Northern Pacific 88 sq. ft. of radiating surface is used per 100 cu. ft. of free air displacement of the compressor, and one-third of the surface of

the main reservoir was included in the radiating surface, although he believed this was excessive.

EXCESS PRESSURE

BY M. S. BELK

Excess pressure is generally understood to mean the difference between the pressure in the main reservoir and that in the brake pipe. Since my connection with air brake work, 20 lb. excess pressure has been considered the proper amount to carry on all classes of trains. In the past few years we have made many changes in the air brake equipment, necessitated by increased weight of cars and locomotives and the great increase in the number of cars hauled. There are times when we need a higher excess pressure when the brake valve should be allowed to remain in running position. When ascending long grades, we always have quite an increase in brake pipe leakage. In addition to this, the compressor is called upon to furnish then more air than at any other time for sanders, fire doors and sometimes the bell ringers. Should we be unable to maintain the proper excess, does not the feed-valve commence to close? If so, do not the brakes commence to creep on? This very often necessitates "doubling."

We were not in a position to materially increase the compressor capacity immediately and it was up to the "air-man" to do something. So, in our efforts to overcome the trouble, we increased our excess from 20 to 30 lb. with excellent results.

DISCUSSION

It was stated by several members that if the feed valves and their connections were kept in proper condition, and the leaks in the train line brought down to the proper amount there would be no necessity for carrying more than 20 lb. excess pressure in the main reservoir. Some members recommended that the feed valve be tested every two weeks, and one member stated that every week was plenty long enough for them to run. An imperfectly maintained feed valve is responsible for the brakes creeping on and for stuck brakes. It was also stated that the need of excess pressure was due to insufficient capacity of the compressor. On the long trains carrying an excess pressure greater than 20 lb. the pump is liable to run hot. On the Santa Fe soap-suds tests are applied to the hose, and tests for leakage are made to every car sent to the repair tracks, whether it is sent for air brake repairs or not.

RECOMMENDED PRACTICE

Under heading "Gages," sub-heading "Location," the following articles should be added: (4) All cabooses should be equipped with an air gage. (5) Caboose gage should be lighted with a lamp arranged with suitable shades that will permit the light to show only on the face of the gage. (6) Gage location to be such as to permit of readily noting the pressure either from the cupola or the conductor's desk. (7) Caboose gage should be of good quality and the dial should be not les sthan 5 in. in size. (8) The ¼-in. pipe to air gage to be provided with a tee head cut-out cock and between cut-out cock and gage a plug tee to be provided for use in carrying on necessary tests with caboose gage.

Under heading "Triple Valves," sub-heading "Cleaning and Repairing," the following article to be added: (10) In cleaning emergency valve seats no sharp instrument should be used that would possibly scratch or mar it. All flat seats should be re-machined to the standard half-round bearing.

Under heading "Piping," sub-heading "General," Article 2 to be changed to read: All pipes should be hammered and thoroughly blown out before being connected and all pipe ends to be reamed full size after cutting.

Under heading "Foundation Brake Gear," sub-heading "Leverage," Article 11 to be changed to read: Foundation brake gear on all modern passenger equipment cars should be designed so as to withstand 105 lb. cylinder pressure.

The report was signed by: S. G. Down, chairman; H. A. Wahlert; N. A. Campbell; J. R. Alexander and N. A. Clarke.

OTHER BUSINESS

Other papers and reports were presented on Piping of Locomotives and Cars, and Hand Brakes for Heavy Passenger Cars. On Wednesday afternoon a lecture on the manufacture of iron tubes was given by R. W. Kenney, of the A. M. Byers Company, Pittsburgh. Motion pictures were shown illustrating the lecture. Walter V. Turner made a novel and interesting talk on Thursday afternoon. He showed by means of motion pictures the operation and the manner in which the air flowed through the various passages of the U. C. triple valve during the charging service application, emergency application and the releasing of the brakes. The possibilities of illustrating brake performance by this method is well worth considering in the matter of instruction. Mr. Turner also showed illustrations of various freak inventions which were both interesting and amusing. T. O. Sechrist, master mechanic, Louisville & Nashville, also addressed the association during the Thursday morning session.

The secretary reported a total membership of 1,177, and a cash balance of $1,360.90. There were over 200 members present at the convention.

The following officers were elected for the ensuing year: President, T. W. Dow, Erie Railroad; first vice-president, C. H. Weaver, N. Y. C. West of Buffalo; second vice-president, C. W. Martin, Pennsylvania Railroad; third vice-president, F. J. Barry, N. Y. O. & W.; secretary, F. M. Nellis, Westinghouse Air Brake Company, and treasurer, Otto Best, Nathan Manufacturing Company.

CLEANING PASSENGER CARS

The exterior of cars when very dirty from rain and dust should be thoroughly washed by means of a hose with a small nozzle and a brush on a long handle, one man using the brush while the other applies the water. This also applies to the trucks. When the windows are dry wipe them off with dry white waste or cheese cloth. This will in most cases give the outside a good appearance. In stormy weather this cannot be successfully done unless the cars are in a shed for protection. Air cleaning for the interior is preferred, as all dirt and scraps of paper can be cleaned out from behind and under steam pipes; then the ceiling and walls can be uniformally cleaned, as well as the lamp shades. The cushions should be thoroughly beaten about twice each week, taking them out of the cars and placing them on a rack made for that purpose. All seat arms and window sills should be thoroughly cleaned with white waste or cheese cloth.—*W. T. Clanton.*

Choosing Steel or Malleable Iron Castings.—The choice between steel and malleable iron castings is dictated partly by their respective properties, partly by price and partly by the limitations of the processes by which malleable iron is made. As pointed out in a paper read before the International Engineering Congress, steel is, in its nature, a more homogeneous metal and therefore tougher and stronger than malleable iron. Moreover, castings of malleable iron are somewhat prone to actual porosity or sponginess at the center, especially in certain portions of irregular castings, so that for this reason also a steel casting is stronger and more reliable. Finally malleable iron can be made only into castings of quite light sections, whereas there is almost no limit to the size and weight of steel castings that can be produced. For uses where only a fair amount of strength and toughness is necessary, and the castings are therefore of light section, it often pays to buy malleable castings, because they are cheaper than steel.—*American Machinist.*

How to Develop the Car Inspector

Suggestions From Several Viewpoints Which Were Made by Contributors in a Recent Competition

One of the most successful competitions which we have ever held was that for the car inspectors, which closed October 1, 1915. A number of the contributions to this competition were published in the November and December, 1915, and the January, February and April, 1916, issues. The present article is made up from the more important parts of papers which were presented by four contributors whose experiences enable them to comment on the subject from widely varying viewpoints.

BY W. E. PATTERSON
Air Brake Foreman, Car Department, Pittsburgh, Cincinnati, Chicago, & St. Louis, Logansport, Ind.

Men are being trained as car inspectors by practical experience and also by instruction in classes, which are held once a week in charge of a competent man, in order that they may become familiar with and thoroughly understand the rules of interchange and the laws as applied by the interstate commerce commission or government inspectors. We find that the best results can be obtained in the application and maintenance of United States safety appliance standards by dividing the work on the repair tracks into three classes, viz., truck inspectors, air brake inspectors and car body inspectors. This arrangement divides the responsibility, facilitates instruction and brings about better supervision.

The men are furnished with literature on the subject of car repairs and by close application and study become fitted to fill the next higher position. In past years very little literature was available on this subject at a price within the reach of all. This condition developed two classes of men. The one who studied became a theoretical man and the one who labored without study became the practical man, but the theoretical man was always the man selected to fill the higher positions; today conditions have changed. Literature may be obtained at a price which is almost ridiculous.

No man can become a competent car inspector without practical experience and study. The air brake, the rules of interchange and the laws of the country governing the maintenance of cars have become so broad and complicated that study is imperative.

BY S. E. NELL
Foreman, Chicago, Rock Island & Pacific, Carrie Ave. Shop, St. Louis, Mo.

A remark common among officers and foremen is to the effect that a car inspector is merely a necessary evil; in other words, he is stationed in the transportation yards to detect defects, and then proceed to bad order a car to the repair tracks. It is quite true that the inspector is necessary, but as to being an evil depends entirely upon his qualifications and training.

To become a successful interchange inspector the man should be promoted from the repair tracks to light repairman or safety appliance inspector in the train yards, inspector in straight inspection, and finally to the interchange point. The foreman of a repair track who makes a close study of his men will invariably find some who will qualify above the others in the gang and show more alertness, and these should be selected to make the start for better positions.

By first placing the candidate for the position of car inspector in the transportation yards as light repairman or safety appliance inspector, whichever he may be termed, he will familiarize himself with the handling of trains and gather information which will be of advantage in fitting him for the higher position. After the man has served enough time, and this must be left to the judgment of his foreman, he should be promoted to car inspector, preferably in a straight inspection yard, where little or no interchange work will be necessary, but using him as extra inspector at an interchange point as much as possible, by swinging him in for the regular interchange man at times he is off duty. When the interchange opening occurs the foreman will not only have an available man, but one really fitted to become an ideal interchange inspector.

During the time of his training he should be schooled in the Master Car Builders' rules, and by the practical experience gained should be thoroughly familiar with the use and interpretation of these rules.

Foremen, by keeping in close touch with their men, not only perform a service toward the men, but also to their employer, as it will not only develop better workmen, but will prove an incentive to the car men with ambition and lift the entire department to a higher plane.

Some of the most prominent and best qualified men in car department affairs today have risen from the ranks of inspectors.

BY J. E. HELMS
Head Car Inspector, Atchison, Topeka & Santa Fe, Pueblo, Colorado

It is extremely important that the car inspector be honest, hardworking, have a fair education, know how to write a legible hand, be sober, and, above all, he must possess that indispensable qualification, judgment. No other endowment is quite so essential.

The M. C. B. rules are very complicated, and a thorough study of them, linked with some practical applications, will give the average car inspector a working idea of their intent and purpose. Along with this knowledge must be carried that of the local agreements, which, when governing the handling of traffic between several systems, become very complicated and often more difficult to apply than the M. C. B. rules.

If he be a yard inspector handling trains in and out of a terminal he must know the local rules of agreement and the M. C. B. rules; also how to handle the air and air brakes on passenger and freight trains in and out of the terminal; along with this he must also know how to execute the general orders with faithfulness and be governed by the bulletins issued from time to time by his superior officers.

The requirements prescribed by the interstate laws governing the standardizing of equipment must be thoroughly understood by the car inspector.

With these duties to perform, it is clear that he must of necessity be a very exact and intelligent individual, and though he has never been recognized as such, he is nevertheless one of the most important and useful employees of the railroad. Promotions come slow, owing to the fact that in his particular line of work he is set apart and usually away from the shop work or other duties connected with the car department, and thus little is known of his ambitions and many places are filled with men from the other departments for which he should have been considered.

In the past he has gathered his knowledge largely from his associates, and while he may have become proficient as to its general demands, yet he has been handicapped in becoming thorough and practical in every sense of the term in that he has not had or been given the support by the foreman and officers and many of the employees in the other departments, and thus has not been recognized as being an important factor in the road's development; but these conditions are fast changing, and soon the car inspector will attain a

relative position among railway employees, more in keeping with his work and responsibilities.

BY J. A. SOUDERS
Hazleton, Pa.

The duties of a live and efficient car inspector are so numerous and the proper inspection of cars so vital to the operation of railroads that a car inspector must be more than a mere "car knocker." In order to obtain sufficient men for the position, it is necessary to give more time and attention to their training and development.

The youth who aspires to become a car inspector must of necessity have at least a common school education, embracing the three "R's"; reading so he will be able fully to interpret the meaning of the rules and instructions; writing so he will be able to neatly and legibly prepare billing, repair, defect, return, bad order, transfer and other cards, and keep the records neatly and correctly; arithmetic to make the various computations and keep such accounts as may be necessary.

If he has the above qualifications to start with, and is bright and active, not afraid of good hard work, and is given to understand that he will be given a chance to work himself up, by proper training he may be developed into a watchful, cool-headed and reliable car inspector, of whom the employer need not be ashamed, and who in time will make an excellent man for positions higher up.

As to his development, theory is a good thing, but not in itself; and in order to combine theory with the practical the young man should be employed at a car shop or in a car repair yard, preferably in the light repair gang, so he will become familiar with the different parts of the cars, the different kinds of cars, and the important as well as the weak parts of car construction and the various car failures.

He must also become familiar with the air-brakes, hand-brakes, safety appliances, couplers, uncoupling devices, etc. At the same time he should be given literature on cars and their parts, a copy of the M. C. B. code of rules, and should be a reader of the *Railway Mechanical Engineer*, to enable him to study up. If after a time he has made good, and can pass a physical examination, he should be promoted to the car inspector's force, under the eye of a capable foreman, until he is able to "hoe his own row."

To still further bring out the best that is in him, he should later be placed at a one-man inspection point, where he must look out for himself, and think and act for himself, thus making him careful, resourceful and efficient.

Another method, when it is not possible to start the young fellows out at a car shop, is to take from the ranks of car cleaners such men as have proven bright and observant, who want to make something of themselves, and are qualified in so far as educational and physical requirements are concerned. Their experience while engaged in and about cleaning cars is such that they will have absorbed considerable knowledge by seeing cars coupled up and uncoupled, brakes tested, seeing inspectors go over cars, and possible they may have given a hand in emergency cases. If given the necessary literature, and handled in the manner above outlined, they may also be rounded out and developed into good car inspectors.

The men while in course of development should be given all practical pointers, be encouraged if progressing satisfactorily, or reproved and cautioned if in error, and also be fully instructed and examined on automatic air-brakes, safety appliances, and special rules of the company; this, together with the close observance of the M. C. B. code of rules and other car literature, will, in a short time, make them reliable and efficient car inspectors.

The qualifications of a real car inspector are, of necessity:

1. He must be sober and conscientious.

2. He must be careful and vigilant to discover defects and irregularities on equipment, which the untrained eye may not be able to discern or which may appear trivial, yet which may endanger a train, or make cars undesirable or unsafe for movement.

3. He must work for the full interest of his road, and yet deal squarely with other roads, if at a junction point.

4. He must always be on the job, regardless of the weather, and bear in mind "Safety First" for himself, and others for his company's interest as well as for his fellow men.

5. He must have patience, so as not to "fly off the handle" at every little provocation, nor if other employes "jaw at him"; if he knows his business and attends to his business, right and proper, "He should worry."

6. He must continually study the M. C. B. rules, rules for loading materials, the various devices, new types of cars and materials, and read up on power and hand brakes and other car literature.

7. He must always use good judgment and think and act quickly.

To briefly sum up the required qualifications of a car inspector, we might say that they are: To be sober, industrious, studious, watchful, careful and reliable.

DISMANTLING OF CARS*

BY J. W. GERBER
General Storekeeper, Southern Ry., Washington, D. C.

This paper is based on our experience in dismantling approximately 2,600 cars during the past four months. We began the work by hand, in a limited way, and as an experiment, about one year ago, so that when the order was received to dismantle 1,850 cars, and complete the work within 60 days, we had some knowledge of what was ahead of us.

The cars were unequally distributed at divisional points, the lowest number at any point being 1, the highest 539. Additions were made from time to time to the original assignment of 1,850 cars, the total having reached 2,900 to date, of which 2,600 have been dismantled as of May 1.

In doing the work the regular storehouse organization was used, requiring the addition of only common laborers to the regular labor forces. It was desired that special records be kept of the salvage derived from the cars, and at the points where any considerable number of cars were to be dismantled, special traveling auditors were assigned to the work in connection with their other duties. The material to be saved for the construction of other cars, or for use in repairs to cars, was passed upon by inspectors of the mechanical department, and every effort was made to save all the material for which service could be found.

While there was some variation at the different points in the method of dismantling the cars, the general plan was about as follows: Where possible, one or more tracks were secured that would hold from 10 to 20 cars each, the cars being spaced about ten feet apart. Four men were assigned to each car and the work on box cars was begun by two men stripping off the roof and two men removing the grab irons, brake staff and outside metal. The men removing the roof, before leaving the top of the car, loosened the siding at the plate, using for this purpose chisel-pointed bars. After removing the roof, outside metal and doors, the four men take down the lining, loosen the belt rail, and remove the siding. The upright rods are cut at the floor level, the longitudinal rods are taken out, the frame work is thrown to the ground and the rods still remaining in the frame are driven out. Two men remove the deck while two men take down the draft rigging and remove the air brake material. The bolts are drifted from the sills and the sills rolled to one side of the truck and turned over to the clean-up gang. If the trucks

*A paper read at the thirteenth annual convention of the Railway Storekeepers' Association held in Detroit, Mich., May 15-17, 1916.

are to be dismantled, that work is done by the four men, if not, the gang is ready for the next car.

It has been our experience, in removing the siding from box cars, that the greatest difficulty lies in getting the material off in such condition as to be of some future service, and at the same time not to expend too much money in the work of taking it off. The largest use we have found for the siding is in re-working it for roofing boards, and while the length of the siding is sufficient to allow of some waste in cutting for roofing boards, it is necessary to remove it with with either chisels or chisel-bars, as a man using a sledge hammer will produce mainly scrap wood.

The number of men in the clean-up gang varies with the local conditions, and if any considerable number of cars are to be taken down, consideration should be given to the location of the tracks on which the cars are to be dismantled, and the facilities for taking care of the lumber and metal reclaimed from them. Our best results were obtained with the following organization: One foreman; seven gangs of four men each taking down cars, and twelve men in the clean-up gang, a total of one foreman and forty men. Cleaning the track, assorting the metal, classifying and piling the lumber was done by the clean-up gang. This organization would dismantle not less than seven cars daily, working nine hours per day; while, as the gang became more efficient in the work the time of taking down the cars was reduced in many cases to 32 hours, or the time of four men working eight hours each.

What does the work of dismantling cars cost, and does it pay? It is not my intention to state the cost of labor in dismantling a car, but rather to give the number of hours in which a car can be dismantled, and any one interested in the problem can then apply the necessary labor rate.

Estimating the second hand lumber reclaimed at only 1,000 ft., board measure, per car, and at a value of $10.00 per 1,000 ft., the lumber reclaimed from a box car will more than pay for the entire cost of dismantling the car and the handling of the serviceable material and scrap. To the saving effected by the second hand lumber there can be added at least $1.00 per car for scrap lumber. There is a good demand for the second hand lumber. Freight car siding is cut to roof board lengths and is also used for the sheathing of buildings. Car lining is used for sheathing; car sills for foundation work and framing; and car decking for platforms. Material for a transfer shed, requiring about 325,000 ft. of lumber, was supplied by using reclaimed freight car lumber.

Additional savings will suggest themselves to any one familiar with the conditions of the metal from burned car bodies. Not only are the bolts, nuts, washers, forgings and castings in much better condition for use, if serviceable, but on the completion of the work of dismantling the cars you have all of the material, both serviceable and scrap, assorted and classified. This saves at least $2.00 per car.

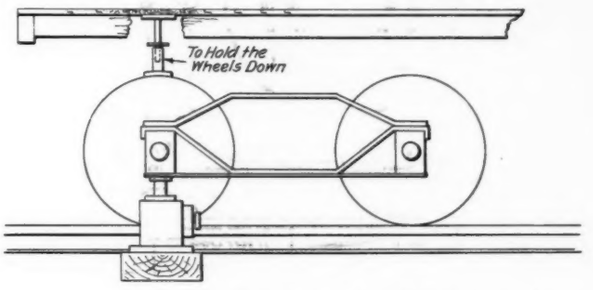
In conclusion, the dismantling of cars is no longer an experiment, it having been demonstrated that savings can be effected in comparison with the burning of the car bodies, the reclaimed material having a value very much in excess of the entire cost of the dismantling of the cars.

PORTABLE TOOLS.—An important factor in shop work is the portable electric motor drilling and reaming machine which has been developed in several efficient forms during the last decade. These portable machines, supplemented with the pneumatic riveting, chipping and caulking hammers, have virtually revolutionized shipbuilding, bridge-building, and structural steel work, and in the erection shop have wrought great changes, making possible rapid and efficient machine work on the parts as erected and thus saving labor and time through the elimination of transport to and from stationary machines.—*A. S. M. E. Journal.*

HOLDING DOWN WHEELS WHILE CHANGING BRASSES

BY W. E. LEMP
Foreman Planing Mill, Louisville & Nashville, Mobile, Ala.

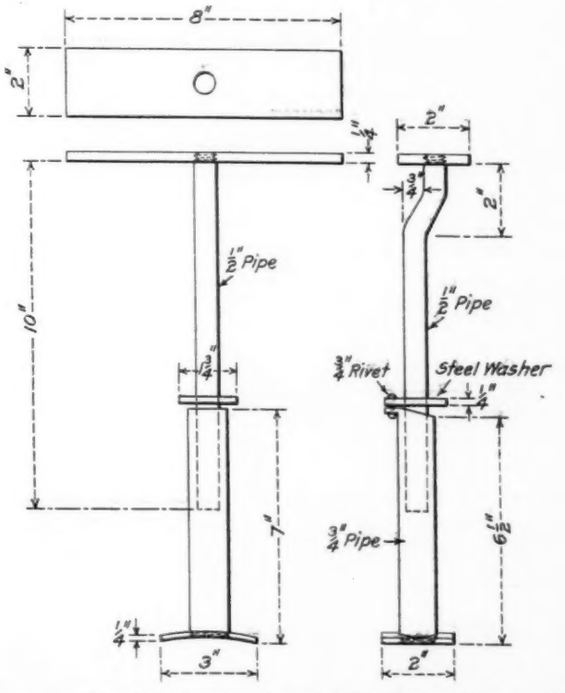
Considerable difficulty is usually found in changing journal brasses on the road owing to the fact that the wheel comes up with the box when the latter is lifted with a jack. A device has been developed by the writer to overcome this difficulty which is light and very simple to operate. It consists of two sections of pipe, one of which fits inside the other, and an automatic clamping washer which prevents them



Device Applied Above a Car Wheel

from telescoping when under load. A ¾-in. pipe forms the lower section, and on the end of it is screwed a face plate curved to fit the tread of the wheel. The upper section is a piece of ½-in. pipe to the end of which is attached a plate 8 in. long by 2 in. wide.

The method of operation is clearly indicated in one of the illustrations. The device is placed on top of the wheel and



Automatic Clamping Device for Holding Down Wheels When Changing Brasses

extended until the top rests against the under side of the car frame. As the journal box is raised the upward pressure of the wheel causes the clamp to grip the ½-in. pipe and prevent it from telescoping into the larger pipe, this action resulting in the holding of the wheel to the rail and facilitating the removal of the brass.

SMOKE JACK FOR PASSENGER CARS

The revolving smoke jack for use with dining car ranges has usually proved unsatisfactory. The bearing is often clogged by a collection of cinders which prevents the hood from turning and in winter snow often banks up against it with the same effect. While the car is standing in a terminal if one of these ventilators happens to be turned the

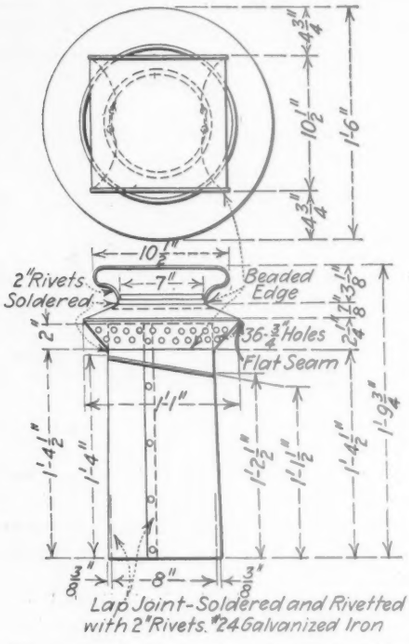


Fig. 1—Range Smoke Jack for Dining Cars

wrong way when the fire is started in the range, the car is usually filled with smoke and it is necessary to send a man up on the roof to adjust the position of the hood before a satisfactory draft can be secured.

In Fig. 1 is shown a substitute for this type of hood which

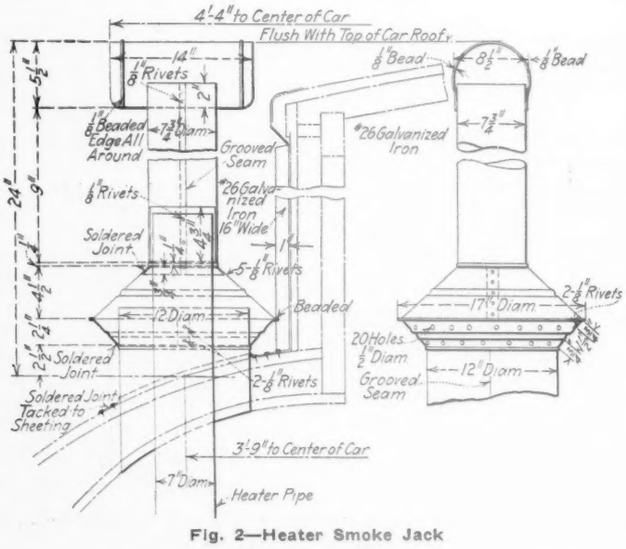


Fig. 2—Heater Smoke Jack

has been developed on the Canadian Northern and which has been made standard for its dining cars. This is a simple form of tee jack, the body of which is built up of No. 24 galvanized iron, the joints being both soldered and riveted.

With double coil heaters, having a barrel measuring from 20 in. to 24 in. in diameter, a 5-in. smoke pipe was formerly used. This, however, has been changed to a 7-in. pipe with much better results. The type of jack now used is shown in Fig. 2. This jack is provided with a hood, as it has been found that unless the opening is protected rain and snow are driven down the pipe into the heater. The openings in the hood are placed laterally so that a slight vacuum is created when the car is in motion and the draft thereby accelerated. To secure the best results it has been found necessary to locate the jack with the top of the hood flush with the top of the car roof at the center.

HAND BRAKES ON MOUNTAIN GRADES

Legislation requiring the use of air brakes on freight cars was enacted primarily in the interests of safety to the trainmen and not to facilitate railway operation, although the inventor and the railroads had both purposes in view in developing the air brake. In the decision of the United States court of appeals, Ninth district, which was noticed in the Railway Age Gazette of April 7, 1916, the court used this language in one of the sentences in the summary of its opinion:

> The language of the act was equivalent to declaring that after the date named, freight trains should not only be equipped to run, but should actually be run without requiring brakemen to use the common hand brake.

In the first sentence of this summary, however, we find this statement:

> It was the intention of Congress by the power brake provision of the safety appliance acts (27 Stat. 531; 29 Stat. 85; 32 Stat. 943) to make it unlawful to require brakemen to use hand brakes in the ordinary management and movement of freight trains in interstate commerce.

Again we find in the opinion of the court this statement:

> The act by its terms expresses with sufficient certainty the intention of Congress that hand brakes shall not be used on freight trains in the ordinary movement of such trains in interstate commerce.

What is meant by "the ordinary movement of such trains in interstate commerce?" Is not operation on mountain grades abnormal, and should it not be considered as other than ordinary movement? On level roads gravity tends to assist the brakes in stopping trains, but on grades gravity works against the brakes. The efficiency of the air brake cannot be questioned, but in the interests of safety to the trainmen, it is not advisable to rely upon it entirely in operating on mountain grades, even though the brakes be in 100 per cent operating condition. The sudden failure of the air pump, error on the part of the engineer in handling the brakes, or a number of other factors which depend upon the human element or are beyond human control, may prevent the most efficient operation of the brakes and result in serious accident unless they are supplemented by the use of hand brakes. In operating on such grades brakemen should be so stationed on the train that in case of emergency they may be called upon to operate the hand brakes. On the other hand, the railroads cannot be excused from seeing to it that the brakes are maintained in the very best possible condition and that so far as it is humanly possible, such trains be braked 100 per cent. In the interest of both safety to life and protection to property operation over mountain grades should be construed as abnormal; the act is so worded that it was undoubtedly the intent to allow the use of the hand brakes, as far as it might be necessary, in such cases.—*Railway Age Gazette.*

Exports of Quicksilver.—The records of the Bureau of Foreign and Domestic Commerce, of the Department of Commerce, show that the exports of quicksilver from the United States for the calendar year 1915 were about 3,300 flasks, valued at an average of about $67.73 per flask, against exports of 1,445 flasks in 1914. The imports entered for consumption are estimated for 1915 at 5,200 flasks, valued at about $52.70 per flask, against 8,198 flasks in 1914.—*Southern Engineer.*

Shop Practice

REPAIRING ANGLE COCKS

BY HOWARD W. STULL
Foreman Machine Shop, Philadelphia & Reading, Reading, Pa.

Probably very few railroad employees realize the large amount of money spent in maintaining angle cocks on railway equipment. When one considers that it requires two for each engine and car and that on the Philadelphia & Reading, for instance, there are over 1,000 locomotives and 50,000 cars, the fact that the aggregate value of the material involved is large, can readily be understood. In addition to the more than 102,000 angle cocks required on this equipment, it must be remembered that the store houses must carry a large supply to replace those that are broken or removed for repairs, which it is safe to say amounts to about 15 per cent or 20 per cent of the number in service including those which are in the shops for repair. This could probably be reduced if the engine houses and car inspectors would send in angle cocks to the repair shops more promptly.

At the Reading shops a department has been organized to

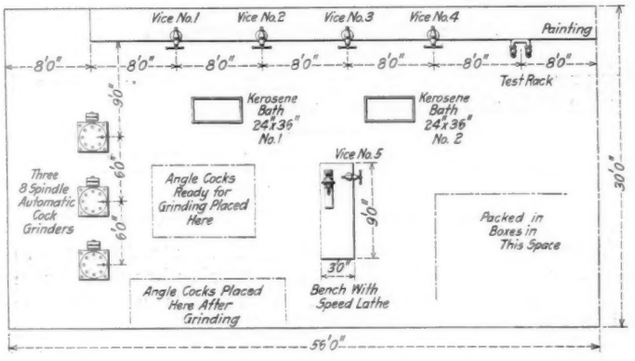


Diagram Showing the Layout of the Angle Cock Repair Department, Philadelphia & Reading

take care of all angle cock repairs for the road, the cocks being sent in from outlying points and redistributed through the store department. The layout of the shop in which this work is done is shown in the drawing. The equipment consists of a long bench on which are four vises, and a test rack, a small bench with a speed lathe, three automatic valve grinding machines belt-driven from a motor-driven line shaft and two kerosene oil baths.

The work is divided into five operations, all of which are paid for on a piece work basis. The first operation is performed at vises No. 1 and No. 2, where the handles and caps are removed. The body is tapped at both ends, and carefully examined both to insure good threads and to save further labor on those that may be cracked. The cocks are then put in the first kerosene bath, where the body and key are cleaned with a brush. When clean they are well blown off with compressed air. Any cocks that are found to have stripped threads on the hexagon end of the body are set aside to be retapped and bushed. This operation, known as "opening" on the piece work schedule, is done for $1.70 per hundred cocks.

The cocks are then taken to the speed lathe bench and the keys screwed on the lathe mandrel, to be checked to run true. They are also eased off on both ends with a file and sand paper. This saves considerable time on the grinding machines. They are very carefully inspected to insure that they have the correct taper. By chalking the full length of the key the bearing can very readily be detected. If the bushing is cut or has ridges in its surface, it is reamed at vise No. 5 and a special size key fitted to it. The taper on these keys is 2 1/16 in. per ft. and the bushings do not require much reaming to renew the bearing.

This operation is known as "examining and filing" and is paid for at the rate of $1 per hundred cocks. It reduces the grinding to a minimum; without it six grinders could hardly take care of the work.

In the third operation the cocks are ground on the three 8-spindle automatic cock grinders, which are operated by one man. A medium grade of Trojan grinding compound is used, this having been found to be superior to ground glass. The price for grinding is $1.35 per hundred and 300 angle cocks are ground in ten hours.

After grinding the cocks are put in the second kerosene bath and the grinding compound cleaned off with a brush and compressed air. They are then assembled at vises No. 3 and No. 4, the handles not being applied until after testing. In assembling, the keys are greased with a mixture of one part beeswax, two parts tallow, and one part woolgrease melted together. Each man assembles 150 cocks in ten hours, including putting on the handles. This operation is known as "closing" and the piece work price is $1.70 per hundred.

The testing is done by a salaried inspector who is held responsible for any poor workmanship on all operations. The painting and delivering to the store house completes the cocks ready for use. The painting is done for $.26 per hundred cocks.

The following is a summary of the operations and the cost per 100 cocks, from which it will be seen that the cocks are repaired for about six cents each.

Opening	$1.70 per hundred
Examining and filing	1.00 per hundred
Grinding	1.35 per hundred
Closing	1.70 per hundred
Painting	.26 per hundred
Total cost of repairs	$6.01 per hundred

NUMBER OF ANGLE COCKS REPAIRED AND NUMBER PURCHASED IN ONE YEAR

	Opened for repairs	Scrapped	Scrapped account loose bushings	Stripped threads on hex. end to be rebushed	Furnished store house	Purchased new
April, 1915	4,908	1,106	307	...	3,894	1,388
May	7,362	590	197	534	6,438	1,502
June	4,296	757	176	280	3,259	2,385
July	4,637	1,208	280	378	3,051	126
August	4,064	325	193	197	3,739	376
September	3,618	164	162	147	3,809	...
October	4,900	480	209	232	4,386	...
November	3,382	399	136	123	2,696	76
December	6,031	620	207	202	3,350	...
January, 1916	4,832	602	201	134	4,112	2,400
February	4,684	635	250	157	3,116	2,502
March	6,364	747	152	127	4,362	2,400
	59,168	7,633	2,470	2,511	46,210	13,155

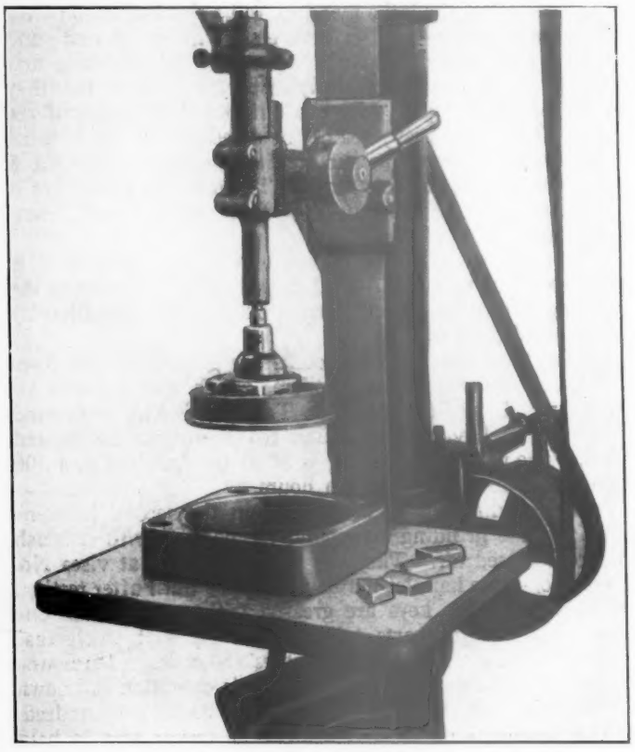
In the table is shown the output of the plant for the year ending April 1, 1916. During this period nearly 60,000 angle cocks were handled, of which over 46,000 were re-

turned to service. The difference was made up by the purchase of about 13,000 new cocks, each of which cost about $1.37.

GRINDING ROD PACKING CONE RINGS

BY W. W. ELFE
Machine Foreman, Central of Georgia, Macon, Ga.

An expanding mandrel is illustrated herewith, which is used in the Macon shops of the Central of Georgia for grinding cone rings and push rings in piston rod packing glands. As shown, it is used on a sensitive drill press, the shank being



Flexible Cone-Ring Grinder for Use on a Sensitive Drill

fitted with a flexible joint to insure uniform pressure on all parts of the surfaces being ground. Two sets of jaws are provided for use in the chuck, one set being shown on the drill table. It has a range from 3¼ in. to 4 in.

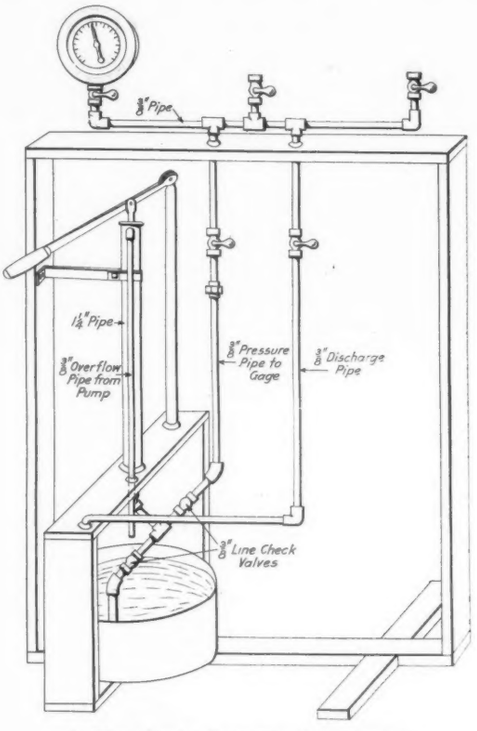
STEAM GAGE TESTING STAND

BY H. E. OPLINGER
General Foreman, Atlantic Coast Line, Brunswick, Ga.

A very cheap but entirely satisfactory steam gage test stand has been developed on the Atlantic Coast Line for use at outlying points. Before this device went into use it was the practice to send a man out from the main shop with the weight machine to take care of this work, paying him time and a half.

The device consists of a simple hydraulic pump drawing water from a tin basin resting in the wood frame, suitable pressure and discharge pipe connections being made to a gage manifold at the top. The gage shown in the sketch must be a new one which is known to give correct pressure readings and should be sent in to the main shop once a month to be checked on the weight machine.

In operating the machine, after pumping up to the pressure desired, the stopcock in the pressure pipe may be closed and the pressure retained while the operator makes the necessary correction in the gage being tested. When the gage is corrected the stopcocks should be opened in both pressure and discharge pipes, thus returning the water to the basin. The degree of accuracy of the work done with this device



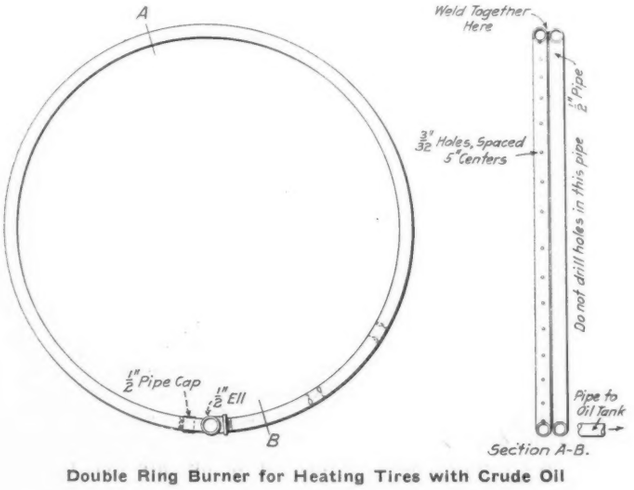
A Shop-Made Gage Testing Machine

has proved entirely satisfactory and its use has been approved by the Federal boiler inspector.

DOUBLE RING TIRE HEATER

BY H. C. SPICER
Gang Foreman, Atlantic Coast Line, Waycross, Ga.

The engraving shows a double ring tire heater for use with crude oil. It will be noted that the first ring has no holes in it, the second ring being drilled. This results in heating the oil in the first ring and generating the proper gas to insure

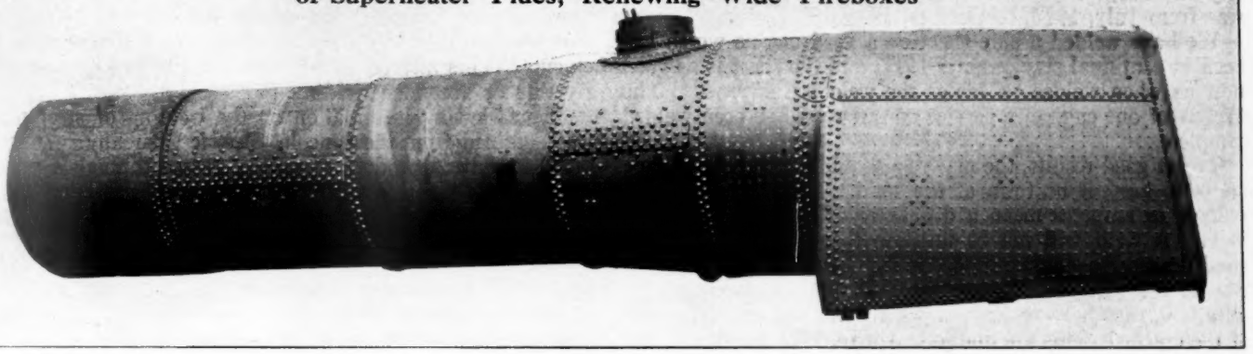


Double Ring Burner for Heating Tires with Crude Oil

burning. We have found this heater very satisfactory for removing tires. The size of the ring diameter is made to suit the size of the tire. This arrangement will heat a tire in one-half the time required by a single ring heater.

MASTER BOILER MAKERS' CONVENTION

Electric Welding in Boiler Repairs, Maintenance of Superheater Flues, Renewing Wide Fireboxes



THE tenth annual convention of the Master Boiler Makers' Association was held at the Hotel Hollenden, Cleveland, Ohio. May 23 to 26, 1916. The convention was opened with prayer by John H. Smythe, a past president of the association, and the welcome of the city was extended by Mayor Harry L. Davis, to which Past President P. J. Conrath responded on behalf of the association. The annual address of the president was delivered by Andrew S. Greene, after which an address by D. R. McBain, superintendent motive power, New York Central, was read by the secretary, it being impossible for Mr. McBain to be present. The following is taken from the address:

MR. MC BAIN'S ADDRESS

I have noted with pleasure the subjects that are to be discussed at your convention. "Oxy-Acetylene and Its Advantages in Boiler Repairs," is one which should be given the closest attention. Notwithstanding the introduction of electric welding devices and the uses to which they can be applied with profit, it would be a mistake at this time to allow the oxy-acetylene process to drop out of our minds in the slightest degree. It has a distinct field in a certain line of work in which it will always prove more advantageous than any of the electric welding processes thus far developed. On the other hand the electric apparatus has a field distinctly its own which cannot well be covered by the oxy-acetylene process. Both systems should have our best thought that they may be developed to their highest points of advantage in our maintenance schemes.

The subject of the vibration of long tubes is one of considerable interest to me because I have made investigations in that line which have demonstrated that there is a certain movement of the tubes caused by excessive heat or cold, which considerably increased or decreased the sag in the longest tubes under the varying conditions of service from the time the fire is first applied to the locomotive until the time it is hauling its train on the road, the indications being that under certain conditions the sag is actually straightened out and under others it is increased.

When an engine with the tubes set in the old manner came in leaking badly it was possible to insert a piece of good thick paper between the bead and the back tube sheet; especially after the engine had partially cooled off. The boilermaker usually went into the firebox as soon as it was cool enough and the repairs usually resulted in clinching the tubes where they were with the ends anywhere from 1/64 in. to 1/32 in. further back in the firebox than they should be. This operation had a tendency, after it had been performed a few times, to shorten the distance between the tube sheets, usually resulting in pulling in the back tube sheet in the zone of greatest leakage. The bulging of front tube sheets may be explained by a study of the conditions above referred to.

In closing his address Mr. McBain stated that he believed that someone, at sometime, would succeed in designing tube sheets which would take care of the expansion and contraction of the tubes in such a way that the stresses now due to unequal expansion would be relieved; and that when this end had been attained a large part of our boiler maintenance troubles would be overcome.

OXY-ACETYLENE PROCESS IN BOILER REPAIRS

At the 1915 convention this subject was very thoroughly covered and the report of the committee this year contained but little which is new relative to the application of the process to boiler repairs.

DISCUSSION

E. W. Pratt, assistant superintendent motive power and machinery, Chicago & North Western, showed a number of samples of the method being used on that road to weld tubes in the firebox tube sheet. A shallow recess is cut in the sheet around the tube hole in which fits a shoulder on the end of the tube, making the end of the tube flush with the tube sheet before welding. The weld is then built up on the end of the tube and the sheet, thus making it possible to remove the tube by chipping off the weld. The tube is set with a copper ferrule. Mr. Pratt called attention to the difference in the service of the welded tubes in good and bad water districts. Where the water is good no difficulty is experienced, but with bad water, welding has so far not proved entirely successful.

It was the generally expressed opinion that oxy-acetylene welding has a wide field of application which is continually extending. Although some members think failures may be due to the quality of the material used, the welder is generally responsible for poor results. At the Collinwood shops of the New York Central, the welders are checked up monthly with tests to determine the quality of work they are doing.

There was a difference of opinion as to the necessity of dropping the sheet when welding longitudinal seams in fireboxes. Where this method is adopted the sheet is usually dropped ⅛ in. per foot, this being taken up as the welding proceeds. A test was referred in which the sheets were tied so that they could not give, with the result that a stress of over 21,000 lb. was thrown on a sheet about 9 ft. long when the weld was completed, thus indicating a necessity for dropping the sheet. Other members use a corrugation to take care of the contraction as the weld cools, while others rivet sheets in place and put in the staybolts before doing the welding and get entirely satisfactory results.

ELECTRIC WELDING IN BOILER REPAIRS

Most of our electric welding has been confined to the welding of flues. Since the installation of two one-man machines at Mount Clare, on each of which we have been running three eight-hour shifts, we have welded flues for 754 engines, 178,890 tubes, and 12,206 superheater flues. This was from July, 1913, to October, 1915.

We have welded a side sheet on a yard engine which has been in continual service since 1913, and the sheet is as good now as when welded as far as the weld is concerned. The firebox of one engine in service on our road has been welded complete.

To get good results, the machine should control the voltage so as to keep it uniform at the weld. Fluctuations in the voltage or amperes mean a difference of temperature at the weld. A weld will not be uniform throughout under such conditions. An automatic controller should be gotten up to control the voltage at the operator's hand. Without proper wire it is very hard to make a good weld, and a great many of the cracked welds are due to bad wire. We are now using a Swedish iron with good results. When welding a crack, the section of crack should be built up, and should be greater than the plate thickness by about ⅛ in. or 3-16 in. Layer after layer should be applied across the width and length of the crack until it is filled up. This method allows the metal to cool and prevents a great deal of contraction by removing the strain from the weld. All parts to be welded must be thoroughly cleaned with a roughing tool or sand blast. The latter is preferable when it can be used, as it cleans the work properly and removes all foreign substances.

Andrew Greene, President,
Master Boiler Makers' Association

The welding of tubes is very important. It is our practice to set all tubes back to head prior to welding, and the boiler must be steamed before welding so as to burn all the excess oil under the bead. If this is not done, the weld will be porous, due to the oil coming out as soon as the welding begins. About the proper amount of current to use to weld tubes at our shop is 60 to 65 volt direct current, 130 to 145 amperes, using 5-32 in. diameter wire and also a flux coated on the welding wire by dampening the wire and then applying flux, the wire to stand until dry. When welding flue sheets, door sheets, and door necks with electric weld, all the caulking edge must be chipped and cleaned with a roughing tool. All fire-cracks must be chipped to 45 deg. bevel. All the work must be caulked with roughing tool to close all pores in the metal after welding. If possible weld the tubes with water in the boiler. The water keeps down expansion and contraction of the tube and head and also exposes all defective welds.

Fireboxes can be welded successfully instead of riveting. Make the welds come in between the first and second rows of stay-bolts, which will stiffen them. To do this the flue sheet and door sheet flanges must be deeper. All mud ring corners can be welded by lapping the weld over the caulking edge. Caulk with a blunt square tool. If this is properly done it will eliminate further trouble. All shell patches can be welded along the edge, which will prevent trouble from leaks.

The average time to weld a set of tubes 2¼ in. in diameter is at the rate of about 20 an hour; for superheater flues, about 6 an hour. It takes about four hours to weld around the caulking edge of a tube sheet measuring about 18 ft. over all, averaging about 40 in. an hour steady welding.

The electric welding process can also be used on smoke-box connections, especially where the smoke-box and extension are in two pieces, thus preventing the possibility of burning and warping the plate, due to air leaking in. Patches can also be welded in smoke-boxes damaged in accidents. This method is safe and reliable and cheaper than riveting or acetylene welding.

The following information on the welding of steel plates was obtained from the Lincoln Electric Company: In sheet metal we have a product which has passed through a process which improves its quality, beyond that of cast steel. The result is greater compactness of the structure with a resultant increase in toughness. The welded piece of sheet metal will consist of two grades of metal, the original metal which has received mechanical treatment and the metal added by the welding process which has not received mechanical treatment and will always have, in general, the characteristics of cast steel. The metal in the weld may be hard or soft, of high or low tensile strength, but it will never have the toughness and ability to resist the tendency to crack in bending that is possessed by the rolled metal.

From the foregoing several general conclusions may be drawn: First, the tensile strength of the cast steel in the weld may be made less than, greater than, or equal to the tensile strength of the metal in the original section; second, the metal may be harder or softer than the metal in the original piece; third, the elasticity of the metal in the weld will always be less than the elasticity of the metal in the original plate.

The character of the finished weld depends on the composition of the metals being welded and upon the skill of the operator. A weld is made when the metals to be welded are in the liquid state with the slag and oxide floating on top. Flaws and imperfect welds in steel are due to the fact that the metals were not properly liquified and the presence of the oxide or slag, or both, prevent a perfect union. It is a notable fact, however, that in autogenous welding the actual union is made in plain view of the operator, so that if it is not perfect, he knows it.

The single riveted lap joint is 55 per cent efficient under the most favorable conditions, while the quadruple riveted double strap joint may have an efficiency as high as 85 per cent. A skillful electric arc welder will make a joint which has an efficiency of 90 per cent without particular effort. Stiffness equivalent to that of the riveted joint may be produced by making the section of the joint greater than that of the unwelded section.

At the present time two kinds of electrode are in general use on sheet metal work: Norway or Swedish iron, or American equivalent, and low carbon steel wire. The iron wire gives metal in the weld of a tensile strength of approximately 40,000 lb. per sq. in., while the steel of .10 per cent carbon content may be relied upon to produce metal in the weld of a tensile strength above 50,000 lb. per sq. in. On plates of ⅛ in. thickness and less an electrode of 1-16 to 3-32 in. in diameter represents the best practice. A current density in the circuit of not to exceed 75 amperes should be used on this

small electrode. Plates between ⅛ in. and ⅝ in. are usually welded with electrode ⅛ in. or 5-32 in. in diameter with a current density in the circuit of not more than 120 amperes. Plates thicker than ⅝ in. are usually welded with ¼-in. electrodes using a current density of approximately 170 amperes. An iron electrode may be melted more rapidly than one of steel and has less tendency to burn than the steel. In general, however, it is more difficult to weld with an iron electrode than with one of steel. To get the best weld possible, the current density in the circuit should be kept as low as is consistent with a usable arc.

D. A. Lucas, 1st Vice-Pres.
Master Boiler Makers' Association

Practically no applications of the electric arc process have been made on plates having a thickness of less than 1-16 in. where a butt joint is required. This is due to the great intensity of the heat with the consequent tendency to "burn through" where the edges of the plate are in small parallel planes. However, they may be melted together with a low current carbon arc with excellent results.

The report was signed by P. F. Gallagher, chairman.

DISCUSSION

The discussion of this report was largely on the welding of tubes at the firebox tube sheet, to which electric welding has been extensively applied. There has been no difficulty in securing excellent results in good water districts, but where bad water is used the results have been much less satisfactory. When the welded tubes begin to leak and are worked over, the welds of adjacent tubes which were previously in good condition are loosened and the trouble rapidly spreads. In some cases, where bad water is used the tubes are welded because of the decreased amount of roundhouse work required while the welds last, although the life of the tube is not greatly extended. With coals which tend to honeycomb the sheet some difficulty has been experienced with welded tubes, the increased thickness of the bead tending to increase the accumulation of honeycomb and the number of steam failures.

On the Union Pacific where firebox sheets are electrically welded the practice of dropping the sheets ⅛-in. per foot was originally followed, it being found that at the completion of the weld the sheet would be drawn up into place. It was found, however, when the weld was pounded lightly with a hammer as the work proceeded, that the sheet did not take up. The strain on the weld had apparently been relieved by the pounding. This practice has therefore been adopted, the sheet being placed with no allowance for contraction.

DO LONG TUBES VIBRATE?

The committee which was appointed to investigate the effect of the motion of the locomotive on tubes of such length and thickness that they sag on being applied to the boiler, presented an abstract of the report of a test made by the New York Central, which was presented before the New York Railroad Club in May, 1910. The test was made on a Pacific type locomotive, the tubes being set with a depression of 1 5-16 in. at the center. A recording device was attached to one of the top tubes, the arrangement being such that the movement of the center of the tube relative to the boiler shell could be recorded. This test indicated that there is some increase in the sag of the tube when the engine is working. The subject was also discussed before the association at the 1905 convention, held in Buffalo, and it was well established that the tube sagged more or less according to the length. This sag was considered beneficial and with the tube submerged in water there is no vibration. The tubes will move, however, to some extent with the surge of the water in the boiler. This report was signed by C. L. Hempel.

DISCUSSION

Considerable difference of opinion was expressed as to the effect of vibration of tubes. Although there are in special cases evidences that considerable vibration takes place, there seems to have been but little trouble attributable to this cause, and in general no more with the long tubes on heavy power than with the shorter tubes on smaller power. Some trouble has been experienced from pitting with long tubes where the shorter ones are but little affected, it being suggested this may be due to the greater strain to which the metal of the longer tubes is subjected due to the greater weight and longer span between supports.

THE BULGING OF FRONT TUBE SHEETS

The sheets have a very small amount of material to assist in keeping them straight. The amount of work and the tools used, as well as the experience of the man doing the work of putting in the tubes, governs the bulging of the sheet, which the following record and experiments will show.

By using hand rollers each hole stretched .007 in. With the self-feeding roller and hand pin the hole stretched .029 in. With the self-feeding roller and air motor the hole stretched .021 in. By taking as a basis a tube sheet having 400 holes, the first method stretched the holes 400 × .007, which equals 2.8 in. The second operation stretched the holes 400 × .029, which equals 11.6 in. The third operation stretched the holes 400 × .021, or 8.4 in. The amount of excess material is distributed over the space worked upon.

As the bridges between the flues do not upset proportionately to the increase in the sizes of the holes, to do the stretching of the material at certain points each individual hole must take care of a portion of the material around it, thus making the bulging of the sheet a local condition. This test was made with a ½-in. sheet and a 2-in. tube, .135 in. thick.

John B. Tate, 2nd Vice-Pres.
Master Boiler Makers' Association

The report was signed by J. B. Tate, chairman, John Smith and Martin Murphy.

DISCUSSION

The generally accepted explanation of the bulging of front tube sheets is the expansion of the tube holes due to working the tubes. Methods of overcoming it or reducing its bad effects to a minimum vary. Some members considered the bulging itself to be of little consequence if proper care were exercised in working the tubes, but they had had trouble from cracking at the heel of the flange. To overcome this the thickness of the sheet has been increased to ¾-in., a ⅝-in. firebox tube sheet being used. Others consider it only necessary to keep the back tube sheet straight, and let the front tube sheet go as it will. The use of a tube sheet with a corrugation adjacent to the flange around the belly of the boiler and over the top of the tubes was suggested as a means of taking up the expansion in the sheet without bulging. A

case was mentioned, however, where a Wood firebox was removed on account of corrosion, in a bad-water district, after 28 months' service, in which the corrugated tube sheets were both bulged, the front about 1in. and the back ½-in.

CLEANING AND MAINTAINING SUPERHEATER FLUES

Keeping superheater flues free from cinders and clinkers depends upon the roundhouse forces, and more particularly upon the boiler foreman and inspector. It is very important that they be inspected before each trip. Flash lights or electric lights with shields should be provided for this purpose. It should be required that the clinkers and cinders be removed from the superheater tubes at the end of each trip. Steel bars from five to eight feet long with a chisel point should be used to break up the clinkers and honeycomb off of the end of the unit and other bars with hooks at the ends should be used to pull the clinkers out of the tube. If they are blown back into the flue they are liable to lodge on the supports of the unit pipes and will soon clog the superheater flues. A ¼-in. or ⅜-in. pipe not longer than the tube should be used for blowing out the soot and cinders, care being taken least three inches from the inside of the flue sheet flange.

The report was signed by T. F. Powers, chairman, and W. M. Wilson.

DISCUSSION

The importance of thoroughly and frequently cleaning cinders from the inside of superheated flues was emphasized. A case was mentioned where cores the full size of the flues and eight inches long have been removed from these flues when they have been neglected, the engines, instead of being better and more economical than saturated engines, becoming less economical.

Thoroughly cleaning the scale from the outside of the flues while they are in the boiler has been found difficult with some kinds of water. It being necessary to enter the boiler while the small tubes were out and knock the scale off by the use of a bar. Although they cannot be cleaned as well as when removed they usually can be made to go until the second shopping for the removal of the small tubes. In rattling the large flues in the barrel type rattler it has been found that they can be handled without injury if the rattler is as completely filled as possible. In rattlers of the submerged type

Chas. P. Patrick, 3rd Vice-Pres.
Master Boiler Makers' Association

Thomas Lewis, 4th Vice-Pres.
Master Boiler Makers' Association

T. P. Madden, 5th Vice-Pres.
Master Boiler Makers' Association

that the pipe is run under the unit pipes, and pulled back and forth until the flue is cleaned. The best time to clean the superheater flues is, of course, at the washout period when the engine is cool, but this depends upon the grade of coal used, for with the use of some coal it is necessary to blow and clean them each trip.

As it is not necessary to remove the superheater tubes at the end of the three-year period in order to comply with the law, if the boiler can be cleaned and inspected, it is recommended by many railroads that the superheater flues be welded at the fire-box end. The tubes can be cleaned on the outside or water side while in the boiler by the use of scraping rods and bars, pneumatic flue cleaners, and sometimes by heating the flues.

When it is necessary to safe end superheater flues, many railroads recommend that not over one safe end be used. When the old safe end is cut off each time it is at least possible to re-tip the tube three times. After that they can be cut down for shorter engines. It is the recommendation of this committee and other boiler foremen that the safe end go on the fire-box end, where the condition is more severe, and where the new material is most needed.

There has been a tendency on the part of some designers to crowd the corner superheater flues too close to the flange of the back flue sheet. This has resulted in cracks out from the flue hole which can only be repaired by welding. Where the welding does not hold, it is necessary to renew the flue sheets. It is recommended that the outside edge of the superheater flue hole be kept at the mixing of 2-in. or 2¼-in. tubes with the flues has been found to prevent denting and flattening of the latter.

REMOVING AND REPLACING WIDE FIRE-BOXES

After removing all tubes, the boiler should be taken from the cylinders and frames and placed on the floor in the boiler shop, all stay and crown bolts drilled out with air drills, or cut off with the electric or acetylene process, cutting mud-ring rivets off with hand chisels or punch and sledge, or by the use of an air hammer or rivet buster; then break the staybolts down with a staybolt breaker or leave them in the old fire-box sheets, dropping the sheets or pieces of sheets on the floor. After this has been done all stay and crown bolt burs can be cut or burned out of the holes. All necessary repairs to the cylindrical parts as well as the fire-box sheets are made and the sheets cleaned while the new fire-box is being fitted up, riveted and caulked.

It is not necessary to remove the back head or disconnect the boiler at throat sheet to apply wide fire-boxes; neither is it necessary to remove any boiler braces, except those applied to the back flue sheets. If the boiler is on the floor and crane service is available, it can be turned over in any desired position. This is a very great advantage.

In applying these fire-boxes the committee differs some as to the manner in which this work should be done. In some localities the sheets are applied one at a time, and bolted up inside of the fire-box casing. Where the fire-boxes are applied in this manner, the rivet holes are all countersunk and rivets driven on the inside of the fire-box by the use of air

hammers. It is claimed that by this method the flanges of the sheets are protected, and there will be less trouble on account of sheets cracking out at the rivet holes. It is the opinion of a great number of men that the boiler should be removed from the frames and taken to the boiler shop. When this is done the fire-boxes should be fitted up, riveted, chipped and caulked, both inside and outside, ready to be put into the casing by the time the boiler has been cleaned and repairs made to the barrel and outside fire-box casing sheets. The fire-box can then be put in place, if cranes are available, by turning the boiler with the mud-ring opening up. After this is done and the fire-box is bolted in place, the boiler is let down on the floor and the fire-box door ring is riveted, usually by driving hammered rivets. In some instances it is welded. The mud-ring is then put in place and riveted with a mud-ring riveting machine or air hammer, and then chipped and caulked, the roof and staybolts being applied in the usual manner. All staybolts are driven with an air hammer or staybolt driving machine, and should be held on with an air holding tool.

Harry D. Vought, Sec.
Master Boiler Makers' Association

The committee does not think it advisable to cut the back head out or disconnect the boiler at the throat sheet at any time to remove any wide type fire-boxes. This is not only an unnecessary expense, but it will destroy a good tight seam or joint. The driving out of the rivets is liable to cause fractures and cracks in the plates. Any wide type fire-boxes can be removed and applied without disconnecting the boiler at throat sheet, or cutting out the back head, by one or the other of the above methods, i. e., by applying the boxes after they have been riveted together, or by putting in one sheet at a time and riveting all inside of the boiler. The only objection to the latter method is that the sheets cannot be brought up tight on the water side, and it is impossible to caulk them.

The report was signed by B. T. Sarver, chairman, A. N. Lucas and Bernard Wulle.

DISCUSSION

The consensus of opinion expressed was in favor of leaving the back end on the boiler when renewing fireboxes. Further than this the methods to be used must depend largely on the facilities of the shop, conditions in this respect varying widely.

CUTTING OFF STAYBOLT ENDS WITH OXY-ACETYLENE

The threads on the staybolts or on the sheet are unduly strained by the use of nippers, and the ends of the staybolts are left with two long corners, making them more difficult to rivet over. The chisel bar and sledge are 50 per cent worse than the nippers in the amount of damage done to the threads on the sheet and staybolt.

The advantages of cutting off ends of staybolts with oxy-acetylene are: First, the bolts are not disturbed after they are once applied; second, we get a uniform length to drive without long corners, and, third, the heat anneals the end of the staybolt. This is a great advantage in the riveting, as the operator is better able to do a good job in upsetting the bolt without leaving any ragged edges. As all staybolts are applied from the fire side of the fire-box, this is a great advantage where a first-class job is desired. Some may think that by cutting off staybolts in this manner the heat penetrates through the bolt to the fire-box sheet, but this is not so, as the operation of cutting is done so quickly the heat does not have time to reach the sheet.

The report was signed by Thomas Lewis, chairman, and W. G. Bower. A minority report was presented by L. Borneman, a member of the committee, from which the following is taken:

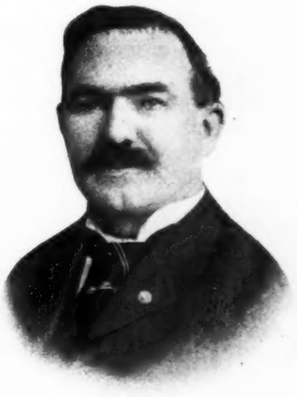
I have been unable to cut off very many staybolts with oxy-acetylene, but I have cut off a sufficient number to prove that we cannot cut them off as cheaply as we can with the staybolt nippers. One-half hour is all the time required for cutting one side of our largest engines, which are the Mikado type. Our nippers are hung from the crane and the bolts are cut off as fast as the machine can be tranferred from one bolt to another. We have the Helwig staybolt nipper in two sizes, one machine for small bolts and one for larger bolts such as radial stays. We have one man rated at 26½ cents an hour who handles these machines exclusively with a helper receiving 23½ cents per hour. I note in cutting the bolts with oxy-acetylene the sheet gets so hot that it is impossible to place the hand on it in some places.

It may be recommended as inexpensive on general repairs to use oxy-acetylene in cutting off a number of bolts scattered on the boiler and as preferable to using a chisel bar.

I do not recommend the application of bolts from the inside sheet. In tapping out a staybolt hole with a motor, the vibration of the motor hanging from a pulley has a tendency to increase the size of the hole where first entered. The hole in the second sheet as a rule is of the original size of the tap. When entering the bolt, it will always be noted that it will not be as tight in the hole that the tap was first entered in as in the second hole; thus you are able always to get a good tight bolt on the inner sheet where it is absolutely necessary in order to prevent leaky staybolts, by applying the bolts from the outside sheet.

DISCUSSION

Where the use of the oxy-acetylene burner has been tried in the removal of staybolt ends it has usually proved successful. Where difficulty has been experienced due to the hardening of the bolt ends or heating of the sheets, making them less easy to rivet, it is attributed to improper regulation of the flame, requiring its application to each bolt for too long a time.



Frank Gray, Treas.
Master Boiler Makers' Association

BASIC VERSUS ACID STEEL FOR FIRE-BOXES

Acid open hearth steel may be distinguished from basic open hearth steel by its being normally higher in silicon and usually in phosphorus, but lower in manganese.

The acid open hearth furnace is heated by burning within it gas and air, each of which has been preheated before it enters the combustion chamber. The metal lies in a shallow pool on a long hearth which is lined with silicious material, and is heated by radiation from the intense flame. The impurities are oxidized by slag lying on top of the metal. This operation is hastened in two ways: iron ore is added to the bath; and the carbon is diluted by adding with the furnace charge large

proportions of steel scrap, often as much as 75 or 90 per cent. It takes from six to ten hours to purify a charge. The manganese and silicon go into the slag first, then the carbon boils off as a gas. When this has proceeded to the desired point, the bath is recarburized and the metal is cast into ingots. The characteristics of the acid open hearth process are: A long time in purification; large charges are treated, usually 15 to 100 tons to a furnace; at least a part of the charge is melted in the purification furnace, and the furnace is heated with preheated gas and air.

The basic open hearth process is similar to the acid process, with the exception that a sufficient amount of lime is added to the bath to form a basic slag. This slag will dissolve all the phosphorus which is oxidized, which an acid slag will not do. The characteristics of the basic open hearth process are the same as those of the acid open hearth process, with the following additions: Lime is added to produce a basic slag; the hearth is lined with basic instead of silicious material, in order that it may not be eaten away by this slag, and impure iron and scrap may be used, because phosphorus and, to a limited extent, sulphur can be removed in the operation.

Acid open hearth steel is believed by engineers to be better than basic, and is usually specified for all important structures, although not so rigidly today as a few years ago. The basic process is less expensive than the acid, because high phosphorus pig iron and scrap are cheap, and the lower cost of materials used more than balances the greater cost of the basic lining and lime additions, and the circumstance that the acid furnace has a higher output because heats are shorter. Acid steel is to be preferred for the following reasons:

A basic slag will dissolve silicon from the metal; therefore, the recarburizer is added to the steel after the steel has left the furnace, instead of in the furnace as in the acid process. Should any basic slag be carried over with the metal, however (which is liable to happen), there is the danger that the ingots will be too low in silicon. They are then impregnated with blow holes. A goodly portion of the acid open hearth steel goes into steel castings, where the presence of blow holes would be injurious.

The recarburizer does not mix with the steel as well as if it were added in the furnace.

A basic slag is more highly oxidized than an acid slag, therefore the metal at the end of the operation is more highly charged with oxygen. For this reason a larger amount of manganese is added in the recarburizer.

It occasionally happens in the basic process, after the phosphorus has all been oxidized in the slag and the operation is ended, a good deal may get back into the metal again. This is especially liable to happen when basic slag is carried over into the ladle before the recarburizer is all in. A reaction may then take place between the basic slag and the acid lining of the ladle, the slag being enriched in silica, and phosphorus forced out of it into the metal.

The committee made no recommendation endorsing either process as the best for the manufacture of fire-box steel. The report was signed by J. C. Clark, chairman, and H. J. Raps.

CRACKING OF BARREL SHEETS

Barrel sheets are likely to crack in any part of the boiler, but cracks occur most frequently in the lower part of the boiler at the girth seams, usually running in girth seam direction. This is caused by pitting or corrosion. Cracks also occur on the lower half of boiler where frame braces or tee irons are riveted or studded to the barrel sheets. The sheets generally crack at the end of the tee or angle irons, the crack running lengthwise of the boiler. These cracks are likely to be found extending in almost any direction, according to the cause. We believe the cracks found here are due primarily to bad condition of the machinery, such as bad pounds or broken frames, causing undue strain upon the barrel sheets at these points.

Cracks occur at the longitudinal butt joint seams between the rivet holes, in a longitudinal direction, or at the edges of outside welt straps, in a longitudinal direction. These cracks are either due to improper design of the boiler, bad workmanship, or possibly poor material, mostly to bad workmanship. Either the sheets have not been properly rolled or the rivet holes have not been drilled and carefully reamed.

Cracks also occur where washout plates are applied to the bottom of the boiler. Such cracks generally begin at the edge of the washout hole made in the barrel sheet and extend outward in any direction. This is caused by decreasing the strength of the sheet in cutting away the washout hole.

The only way to prevent cracking at the bottom of boiler at girth seams is to keep the bottom of the boiler clean and free from the impurities which cause pitting and corrosion. Cracking of barrel sheets where frame braces and tee irons are riveted or studded to the sheets can be overcome to some extent by applying reinforcing plates of proper thickness and design to the inside and the outside of the boiler where the braces or tee irons are located. Cracking at the longitudinal butt joint seams can be overcome by greater care in rolling the barrel sheets and properly drilling and reaming the rivet holes. Cracking at washout plates can be overcome by applying reinforcing plates on the inside and outside of barrel sheets where the washout plates are applied.

The report was signed by C. R. Bennett, C. N. Nau and Joseph McAllister.

DISCUSSION

The point which received the most discussion was the cracking of the barrel where waist sheet angle or tee-irons are attached, this being attributed to interference with free expansion and contraction. On the Chicago & North Western the angles are being applied without rivets, a wearing pad being attached to the boiler shell against which the angle rests. On Mallet type locomotives the weight of the boiler, which rests on the forward carrying saddles, under certain conditions is considered excessive for the sheet, causing a tendency to spring the barrel and start cracks. The importance of properly lubricating the expansion pads was mentioned, the boiler shell being subjected to excessive stresses when the pads stick.

THE FUSIBLE PLUG

The design of the fusible plug is similar to the washout plug in its general construction, except it is not so large, and on its inner face is made conical or concave to a depth within about 3/8 in. or 1/2 in. of its entire thickness; a 1/4-in. drilled hole passing through. This brass plug, measuring about 1 1/4 in. to 1 1/2 in. in diameter, contains the fuse of soft metal which should melt at not less than 650 deg. F. It is applied between the first and second rows of crown bolts or radial stays at the front end of the fire box near the back flue sheet.

The moment water in the boiler becomes sufficiently low to expose this part of the crown sheet to the direct attack of the fire, unprotected by water, the temperature at this point will increase rapidly to such a degree as to cause the fusible metal in the plug to melt and flow out through the 1/4-in. opening in the bottom of the plug, followed by steam which extinguishes the fire without further damage. If the plug is to perform its function, it must be given the proper attention. It should be removed and cleaned at least once every 30 days; preferably at the time of each stay bolt inspection. If permitted to remain in the crown sheet, for an indefinite period, a thin scale will form over the fusible metal and an accumulation of mud will gather around the plug, thus keeping water away from it and causing the soft metal to melt when there is plenty of water in the boiler.

In the foregoing we have dealt with the design of the fusible plug, its function, advantages and abuses, but in the following we wish to point out its positive disadvantages:

First—In placing these plugs between the first and second rows of crown bars or radial stays in forward end of firebox they are subjected to severe temperature conditions and are frequently burned out.

Second—The thickness of the plug places the firebox side an excessive distance from the water. This permits the brass part to reach a high temperature which may be sufficient at times to cause the fusible metal to melt without low water.

Third—Variations in temperature between the plug and the crown sheet surrounding it, render difficult the maintenance of a tight joint in the sheet. The square having become defective, and the threads burned and corroded, it is almost impossible to tighten effectively with a wrench. Therefore, it is necessary to resort to the hammer and caulking tool to stop the leakage, or remove the plug, clean out the threads and apply a new one. This we deem necessary once a week, or at the end of each round trip, water conditions governing. This procedure will rapidly enlarge the hole in the crown sheet, as well as increase the diameter of the plug, making it necessary in a short while to apply a patch, or bush the hole in order to reduce it.

Fourth—The continuous and frequent removal of fusible plugs in order to maintain them tight and serviceable, would require the lowering of the water each time this operation was performed, and when terminated the water would necessarily have to be raised.

The fusible plug has doubtless been used, more or less, on all of the railroads of this country, but seems to have met with disfavor, and is now being dispensed with.

The report was signed by A. R. Hodges, chairman; F. A. Batchman, and Wm. M. Keating.

CLEANING BOILERS WITH TUBES REMOVED

The ordinary method of cleaning scale out of boilers is by the use of the pneumatic hammer with special scaling tools. A light, rapid hitting hammer is believed to be more profitable than an ordinary size hammer, such as is generally used around the boiler shop or roundhouse, being both quicker and less liable to scar the plates.

The use of a wet sand blast for cleaning scale from boiler sheets is open to objection in that it is hard on the operator and makes the shop where the work is done very dirty. The cost per engine is not much less than with the hammer method, but a better job is done.

Some replies received by the committee indicate that a slight scale is beneficial rather than detrimental; cleaning seams, laps, flanges and the lower part of the shell for inspection purposes is considered all that is necessary. This can be done cheaper than going over all parts of the boiler thoroughly. In general, however, thorough cleaning of the boiler is favored.

The conclusions of the committee are:

First—When tubes have been removed the boiler can ordinarily be cleaned by the use of the air hammer scaling tools in from 8 to 15 hours. Where the fire-box has also been removed it will require about five hours longer.

Second—The picks and air tools should not be sharp enough or hit hard enough to scar the metal, not because of any liability to increase pitting, but because the roughened surface is liable to make the next job of cleaning more difficult.

Third—The sand blast method, taking into consideration the cost of sand and apparatus and its maintenance, is no cheaper than the other method. The boiler is much more uniformly cleaned however. The system might be profitably employed where special facilities, such as a cleaning pit with crane service to bring the boiler to it, could be provided.

The report was signed by George Austin, chairman; T. J. Reddy and C. C. Dean.

DISCUSSION

Where the wet sand blast process is used it is necessary to have a fine gravel as sand will not operate successfully. Where the sand blast is used, either wet or dry, it is impossible for any other work to be done around the boiler while the cleaning is in progress.

MR. McMANAMY'S ADDRESS

Frank McManamy, chief boiler inspector, Interstate Commerce Commission, delivered an address before the association on Wednesday morning, from which the following is taken:

A review of the subjects discussed at its various meetings indicates that much constructive work may be accomplished by this association. Its value, however, will be largely if not entirely governed by the accuracy and reliability of the reports submitted, on which the action of the convention is based. Nothing will do more to prevent this association from attaining its legitimate and proper position as a leader amongst authorities on boiler work than presenting matter to the convention as the conclusions of committees that is not based on actual and accurate tests or performance records.

Many of us have been in railroad service when comparatively little attention was paid to the safety of employees, and looking after himself was considered a part of the employee's duty. Something over 25 years ago the number of men killed and injured in railroad service began to attract the attention of the public, and movements were started by the employees to obtain the passage of laws for the promotion of safety for railroad men. It was only after a number of years spent in the work and after a number of laws had been passed and enforced to an extent which proved that it not only was a protection to their employees, but it was actually cheaper to protect employees than it was to pay for their injuries, that the movement was actively taken up by the railroad companies under the slogan of "Safety First."

This association or its members can do a great deal to promote safety. The men of whom it is composed have charge of large shops and many workmen who are engaged in the construction and maintenance of locomotive boilers and their appurtenances, and are therefore responsible in a great measure for the safety, not only of the workmen who construct, but those who operate the product. No industrial operation is of sufficient importance to justify the unnecessary loss of human life in its accomplishment.

The purpose of the locomotive boiler inspection law and of the amendment thereto was to promote safety. The organization created thereby represents but a small part of the work which the Federal Government is doing for the protection of life and limb. In its particular field, however, remarkable progress has been made.

The amendment to the Federal laws of March 4, 1915, extending the work of the Federal inspectors to the entire locomotive and tender, as well as to the locomotive boiler and its appurtenances, has made absolutely no change in the Federal locomotive boiler inspection law, and none in the method of its enforcement. It is true it has added to the duties of Federal inspectors, and perhaps will make it impossible for them to inspect so many locomotives, but no change will be made in the method of handling the work under the locomotive boiler inspection law.

THE MUD-RING AND THE CRACKING OF SIDE SHEETS

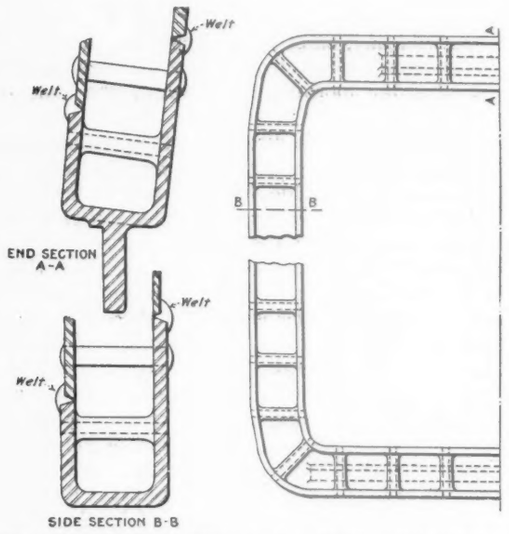
The illustration shows a cast steel mud-ring invented by W. C. Smith, assistant mechanical superintendent, and Charles Harter, mechanical engineer, of the Missouri Pacific.

This ring is channel shaped with flanges on each side to take the fire-box sheet, the inner flange being half a stay-bolt

pitch shorter than the outer flange in order to facilitate the welding of fire-box sheets to same and keep the seam below the fire-line; also to secure a row of stay-bolts in casting and sheet in order to take care of the stresses in welds.

To secure the two walls from spreading and give required stiffness at the bottom of the ring, braces are cast between the walls. In these braces a ¾-in. hole is cored to lighten the casting.

A mud-ring of this description will have many advantages



Cast Steel Mud-Ring Welded to the Sheets, Developed on the Missouri Pacific

over the present ring in use. Being very much lighter in construction naturally makes it more flexible and eliminates stresses in firebox sheets caused by the rigidity of the present design. It will be a smooth surface on side sheets, permitting cinders and ashes to pass into ash-pan and prevent side sheets from rustling away, owing to the rivet heads of mud-ring obstructing ashes that pass between the grates and side sheets. With the mud-ring welded it should also eliminate all mud-ring corner trouble, which is very annoying as well as costly to railroads in bad water districts.

There are many other good features in connection with this style of mud-ring which can be discussed at the next convention.

The report is signed by T. P. Madden, chairman.

DISCUSSION

In presenting the report, Mr. Madden stated that some modifications have been made in the design of the mud-ring since the drawing accompanying the report was made, the bottom of the ring having been changed from a straight to a semicircular form. It is expected that an engine will be equipped in the near future.

OTHER BUSINESS

Wm. C. Connelly, president of the American Boiler Manufacturers' Association, spoke briefly regarding the work which that association is doing in endeavoring to secure the adoption of a standard code for stationary boiler construction.

At the close of Tuesday's session, moving pictures of an educational nature were shown in the convention hall by the National Tube Company.

An invitation was extended to the association by E. W. Pratt, superintendent motive power and machinery, Chicago & North Western, on behalf of the American Railway Master Mechanics' Association, to send a representative to the convention of the latter association, at Atlantic City in June.

A report was presented on "The Best Rules to Follow in Arriving at the Maximum Heating Surface."

On Thursday the convention was addressed by J. T. Carroll, assistant general superintendent motive power of the Baltimore & Ohio, who spoke of the responsibility that all workmen should feel in the kind of work they turn out. In order that the best results may be obtained in this respect it is necessary that all instructions which are given be clear and that the men be properly equipped both with experience and tools.

L. R. Pyle, fuel supervisor, Minneapolis, St. Paul & Sault Ste Marie, called the attention of the association to the growing importance of the spark arrester problem because of laws being enacted in some of the states which seriously interfere with the operation of the locomotive. He urged that the association give this subject attention from the boiler maintenance standpoint in order that there might be reliable information on record for use in combating unreasonable legislation.

The secretary's report showed a membership of 426 at the opening of the convention, and during the convention 61 applications for membership were received. The treasurer reported that the total receipts during the year were $1,130, with a balance on hand at the close of the fiscal year of $553.88.

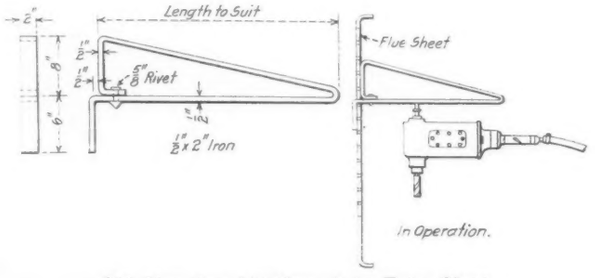
The following officers were elected for the ensuing year: President, D. A. Lucas, C. B. & Q., Havelock, Nebr.; first vice-president, John B. Tate, Penn. R. R., Altoona, Pa.; second vice-president, Charles P. Patrick, Erie, Cleveland, O.; third vice-president, Thomas Lewis, L. V., Sayre, Pa.; fourth vice-president, T. P. Madden, Mo. P., St. Louis, Mo.; fifth vice-president, E. W. Young, C. M. & St. P., Dubuque, Iowa; secretary, Harry D. Vought, New York City; treasurer, Frank Gray, C. & A., Bloomington, Ill. The following were elected members of the executive board to serve for three years: L. M. Stewart, Atlantic Coast Line, Waycross, Ga.; John Harthill, New York Central, Collinwood, O., and John Rapps, Illinois Central.

The retiring president, Andrew S. Greene, was elected to serve as the association's delegate to the convention of the American Railway Master Mechanics' Association.

OLD MAN FOR DRILLING SADDLE BOLTS

BY H. C. SPICER

The illustration shows an "old man," made of ½ in. by 2 in. flat iron, and used for drilling out saddle bolts and steam pipe studs. It can also be used for drilling new cylin-



Old Man for Attachment to Tube Sheet

ders when they are being applied by placing it in a tube hole in the tube sheet at any angle or radius desired.

STEEL FOR GEARS.—For so-called "clash" gears, high-carbon tool steel is superior to casehardened machine steel. Gears made from the latter material are likely to have the hard case chipped off, thereby exposing the soft core to the impact of clashing.—*Machinery.*

ENGINEHOUSE PRACTICE AT MACON, GA.

BY C. L. DICKERT
Assistant Master Mechanic, Central of Georgia, Macon, Ga.

The Central of Georgia has at Macon a 32-stall enginehouse, with 15 outside tracks, all work being done in the enginehouse, so that the workmen are kept out of the weather. All stalls have pits 3 ft. deep by 40 ft. long, which takes in the wheelbase of engine and tank. The pits are of concrete and are well drained and kept clean, so that the workmen can do their work without any inconvenience.

We have installed in the enginehouse a motor-driven drop table capable of removing all driving wheels and trucks from our largest engines at one time. There is very little of this work done, however, as the engines are taken care of in

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CENTRAL OF GEORGIA RAILWAY COMPANY

DAILY LOCOMOTIVE INSPECTION AND REPAIR REPORT

Locomotive No. 1617
Train No. 8
Division Macon.

INSTRUCTIONS—Each Locomotive and tender must be inspected after each trip or day's work and report made on this form whether needing repairs or not. Proper explanation must be made hereon for failure to repair any defects reported, and the form approved by foreman before *locomotive is returned* to service.

Inspected at Macon, Ga. time 2:45 A.M. Date March 15th, 1916.

Locomotive is in good order with exception of following, which should be repaired:

(24) Pack Engine trucks
(24)Left back driving box runs pretty hot, cellars do not seem to be feeding as they should
(15) Clean up headlight.

Does engine steam well? Yes If not, why?

Condition of injectors Good Water Glass Good
Condition of gauge cocks Good Brakes Good
Condition of piston rod packing Good Valve stem packing Good
Safety valve lifts at 200 lbs. Seats at 195 lbs.
Main reservoir pressure 130 lbs. Brake pipe pressure 110 lbs.

Locomotive Failure. Give details of failure, cause or failure, and number minutes lost.

" None"

Fred Gates — Name Fireman. Poarch — Signature Inspector.
H. Swansburg — Signature Engineer. Anderson — Signature Inspector.

The above work has been performed except as noted and report is approved.

Frank Burch — Foreman.

O V E R.....

Inspector's Report (On Reverse Side of Sheet)

(18)

By Engine Inspector Poarch. F. Lift lever broken on Left Side. Right Grab iron to cab does not clear 2½".

(12)

By Tender Inspector Anderson.....Nothing to report.

Fig. 1—Daily Locomotive Inspection and Repair Report

the back shop when all wheels are to be removed. All trucks are removed from engines when they are in need of repairs or lateral is to be taken up in the boxes. Repairs can be made in less time when the trucks are removed. We also have two single drop pits, air operated, for removing a single pair of drivers. On the outside of the enginehouse we have a drop pit, air operated, for removing and applying tender truck wheels.

The enginehouse machine shop has one 26-in. engine lathe, one 16-in. engine lathe, one 44-in. boring mill, one 32-in. stroke shaper, two drilling machines, one sensitive drill, one driving box and rod bushing press, one cold saw, one power punch and shear, one power bending rolls, one bolt altering machine, one single head bolt cutter, one pipe threading machine, one cylinder packing ring saw, a blacksmith forge, a pipe brazing and bending oil furnace, and a tool room for all small tools. The machinery is motor driven.

A standard work bench with two vises is provided between each two pits. The benches have two swinging drawers of cast iron and two lockers in the bottom of the bench encased with wire netting, so that the inspection of the lockers can be made without calling on the workmen for their keys. There are 16-ft. jib cranes placed between every other two pits, equipped with one ton chain hoists and placed at a height to swing clear of smoke stacks. They reach both sides of an engine, making it convenient to remove smoke stacks, front end doors, pistons, etc.

All engines are inspected on their arrival and after all reports are worked up the same inspectors make another inspection before the engines leave the enginehouse for their run. This we find to be a very good practice, as we get a check on the workmen to see that all work reported has been done. Where the inspector finds work not done, or the work improperly done, he makes a report to the enginehouse foreman. The inspection pit is located on the approach to the turntable. All engines are stopped after passing over the

5-10-15—2m bks. Byck Co., 13011 FORM M. P. 81

CENTRAL OF GEORGIA RAILWAY COMPANY

Workman #24 Locomotive Work Card No. 714

ENGINE NO.	ENGR., INSPECTOR, OR FOREMAN	PLACE, TIME, AND DATE
1617	Swansburg	3/15/16

Pack Eng. trucks. Left back Driving box runs pretty hot, cellars don't seem to feed as they should.

FOREMAN

TIME AND DATE WORK COMPLETED	SIGNATURE WORKMAN	APPROVED
	T.H.S.	FOREMAN

Fig. 2—Locomotive Work Card

ashpit where the fire is knocked out and the boiler thoroughly blown out through the blow-off cocks. The inspection pit will accommodate two engines. Provisions are made to enter the pit from the outside, keeping inspectors from crawling between the wheels.

Fig. 1 shows the form of daily locomotive inspection and repair report. A supply of these forms is kept on a clip board in the enginemen's wash room, and after each trip or day's work the enginemen record the work to be done, as shown. These reports are gathered up by a messenger during the day and carried to the enginehouse foreman's office, where they are checked over by the foreman, and if any errors are discovered the engineman making out the report is notified in writing to call at the foreman's office and correct them. The foreman, when checking over reports, places the workman's number opposite the item he is to work up. These items are copied from this form to that shown in Fig. 2, a carbon copy being made on yellow paper. The original ticket is placed in a pigeon hole bearing the workman's number; the carbon copy is kept in the foreman's office. When the work has been completed the workman signs his name and turns the ticket, Fig. 2, into the foreman's office. The tickets for each day are matched up with the carbon or yellow ticket, according to ticket number, date and engine number. (The tickets are numbered, beginning on the first of each month with No. 1.) If the work is not done the workman makes a statement on the back of the ticket as to

why it was not, and signs his name on the back of the ticket.

After the work tickets are made out for repairs to be made, the work reports, Fig. 1, are placed on a clip board and kept in the office where the foreman can look after them during the day. The foreman and inspectors sign the reports each afternoon. The work tickets, Fig. 2, are pinned to the reports, Fig. 1, and the inspector writes up what he finds on the back of the report after checking up the tickets, and knows that all work reported by him has been done. Fig. 1 is filed in daily order and the work tickets, Fig. 2, are filed separately for each day. By this means we know what workman to blame should we have an engine failure due to poor workmanship.

Each workman who handles reports is given a shop number. A case with pigeon holes is located just outside of the foreman's office, and each pigeon hole is numbered to correspond with the workman's number. The work report, Fig. 2, is made out by a clerk, who places the forms in a rack where they are gotten out by the workmen during the day.

We also have placed on the outside of the foreman's office

FORM M P 88

CENTRAL OF GEORGIA RAILWAY COMPANY
MOTIVE POWER DEPARTMENT

Engine 1413 Division Chattanooga To be shopped at Macon, Date March 1916
Class Repairs 4 Last Date General Repairs 3-9-14 191

REPAIRS REQUIRED WITHIN 30 DAYS

Boiler	Good		
Firebox	Good		
Flues	Good	Arch Pipes	Good
Cylinders	Fair	Pistons and Rods Good	Crossheads and Guides Good
Valves	Fair	Links	Good
Eccentrics	Fair		
Injectors	Fair		
Air Pumps and Brakes	Fair		
Driving Wheel Centers	Fair	Tires	2" 6/32 thich 2/32" Wear
Driving Axles	Fair	Driving Boxes	Fair
Shoes and Wedges	Fair	Driving Springs	Good
Trailer Tires	None	Trailer Axles	None
Trailer Wheel Centers	None	Trailer Boxes	"
Rods	Good		
Crank Pins	"		
Steam Pipes	"	Throttle	Good
Engine Truck	"		
Tender Trucks	"		
Tender Frame	Bad		
Tank	Good		
Blow Off Cocks	"	Safety Valves	Good
Whistle	"	Bell Ringer	None
Fire Door	"	Headlight	Good
Engine Frames	"		
Cab	Fair	Running Boards	Fair
Steam and Air Gauges	Good	Sander and Sand Box	Good
Jacket	"	Lagging	Good
Pilot	"	Pilot Sill	Good

Miscellaneous
Engine 1413 out of service since Sept 1915.

THIS REPORT TO BE MADE IN TRIPLICATE AND ATTACHED TO SHOPPING CARD, FORM 1000, WHEN SENT TO SUPERINTENDENT MOTIVE POWER, AND MUST COVER ONLY SUCH ENGINES AS WILL BE SHOPPED AT MACON WITHIN 10 DAYS.

Fig. 3—Repair Report Furnished the Erecting Shop

a blackboard which is posted each morning showing what engines, freight and passenger, stand for every schedule during the day, so that the workman will know what engines are to be worked on first. We have regular men for working on passenger engines and the same for freight engines; also men assigned to dead work.

We have still another blackboard showing pit numbers. When an engine is placed in the enginehouse the hostler writes on the board the pit the engine is placed on and the time placed in the house, and signs his name. The same board has provisions for the hostler signing up for engines taken out of the house. The board is placed at the foreman's office where the foreman or workman can tell at a glance just what pit each engine is on. This saves time in locating engines. Another board located at the same place shows the engines to be wiped, schedule, time, etc. A boiler wash board is also provided showing the engines due for washing; when the boilers have been washed a check mark is placed opposite the engine number. We have a hot water boiler washing system. The house is heated by hot air heating, supplied through a tunnel, with two openings in each pit, making good working conditions in cold weather.

Where the work tickets, Fig. 2, are made out by the day force and not worked up on engines to be used on night runs, the night foreman is furnished with these tickets to work up, and the same from night to day force.

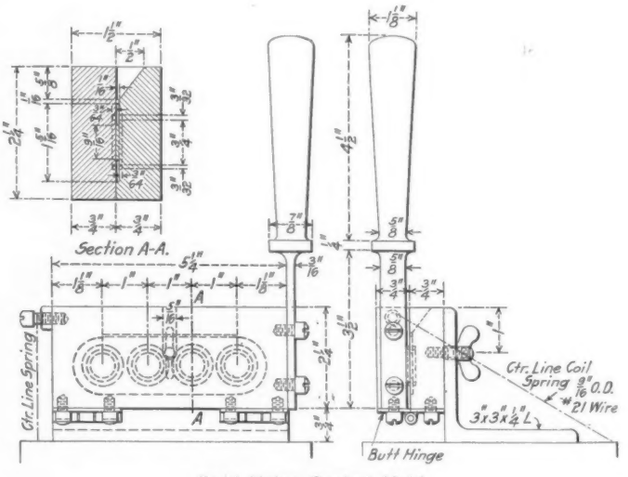
When engines are to be shopped, the form in Fig. 3 is made out and furnished the erecting shop for each engine. This means of handling engines to be shopped enables the shop force to get up extra parts that need renewing and remedy some defects which, under ordinary conditions, would not be found while the engine is undergoing general repairs.

The organization includes a general enginehouse foreman, an enginehouse foreman day and night, an engine despatcher and a clerk, engine inspectors, day and night, safety appliance inspectors, an air brake inspector and boiler inspectors.

MOLDING GASKETS FOR FEED VALVES

BY E. A. MURRAY
Master Mechanic, Chesapeake & Ohio, Clifton Forge, Va.

The drawing shows a simple mold for making lead gaskets for the feed valve connections of the engineer's brake valve, by the use of which we have been able to reduce the cost of these gaskets approximately 50 per cent. The mold is in



Feed Valve Gasket Mold

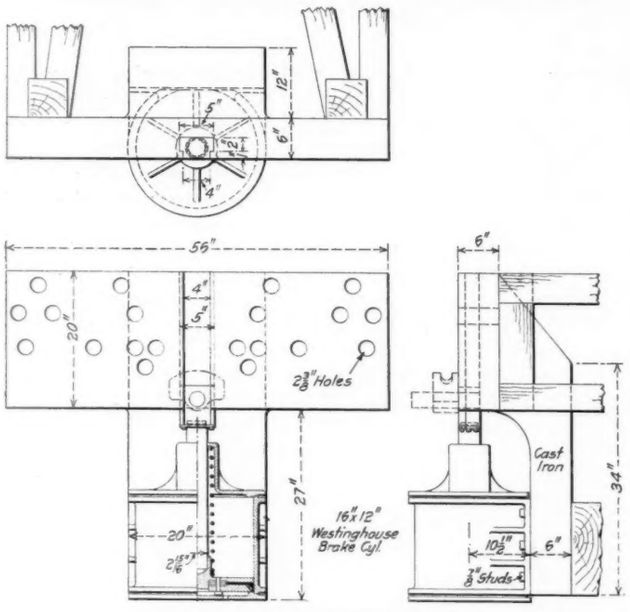
two parts, which are joined at the bottom by a butt hinge, and is mounted on the vertical face of a short piece of 3-in. angle bar. Normally the two parts of the mold are held in the closed position by a coil spring, the position of which is indicated in the drawing. A pouring gate 5-16 in. wide by ½ in. long at the top and tapering to the thickness of the gasket at the bottom is cut in the fixed half of the mold. The finished gaskets are removed by means of the handle attached to one end of the movable section of the mold.

MAGNETIC CHUCKS.—Magnetism for holding steel and iron parts for grinding, planing and turning operations has been made use of, especially for thin parts that are easily sprung out of shape by ordinary clamping means. Magnetic grinding, planing and lathe chucks have come into common use in plants having up-to-date equipment.—*A. S. M. E. Journal.*

PIPE BENDING MACHINE

BY E. A. MURRAY
Master Mechanic, Chesapeake & Ohio, Clifton Forge, Va.

The pipe bending apparatus shown in the drawing consists of a heavy cast iron off-set face plate, to which is securely fastened an ordinary air brake cylinder. The piston of this cylinder actuates a crosshead, which is prepared to receive



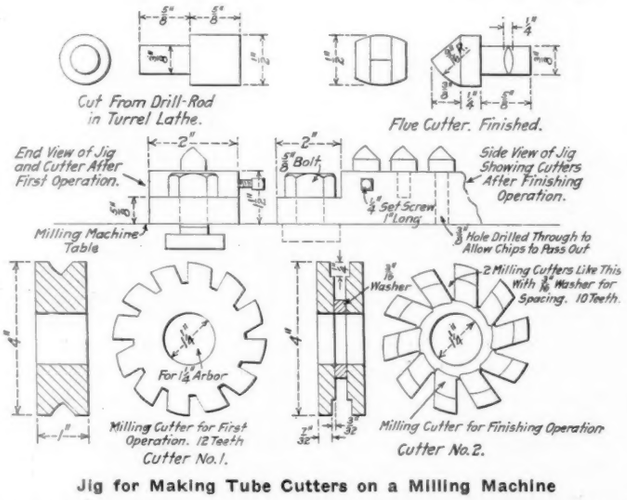
Apparatus for Bending Pipe

forms suitable for the different sizes of pipe generally used in locomotive practice. Pipe can be bent to any radius desired by the spacing of the pins in the face plate.

JIG FOR TUBE CUTTERS

BY EDGAR BARNES
Tool Maker, Texas & New Orleans, Houston, Tex.

The drawing shows a jig for a milling machine, used on the Texas & New Orleans at Houston, Tex., for the rapid and uniform making of tube cutters. This jig was designed

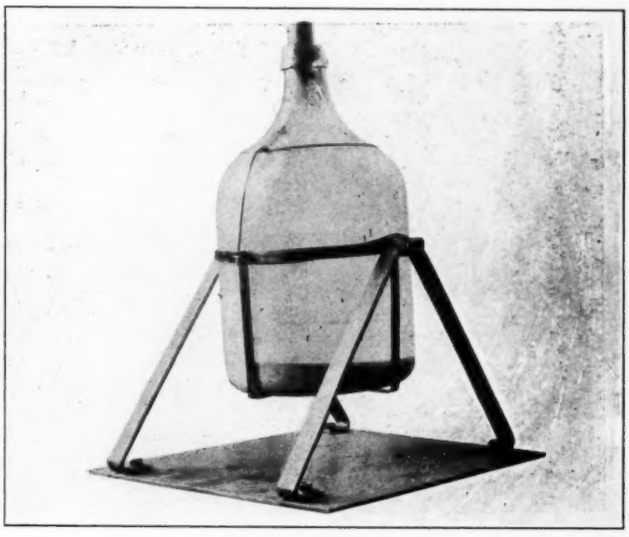

Cut From Drill-Rod in Turret Lathe.
Flue Cutter. Finished.
End View of Jig and Cutter After First Operation.
Side View of Jig Showing Cutters After Finishing Operation.
Milling Machine Table
Bolt
1/4" Set Screw 1" Long
3/8" Hole Drilled Through to Allow Chips to Pass Out
Washer
2 Milling Cutters Like This With 1/8" Washer for Spacing. 10 Teeth.
For 1 1/4" Arbor
Milling Cutter for First Operation. 12 Teeth
Cutter No. 1.
Milling Cutter for Finishing Operation
Cutter No. 2.

Jig for Making Tube Cutters on a Milling Machine

by F. C. Fantry, tool-room foreman. It is made of one piece of steel, 2 in. by 1½ in. and of a length to suit the travel of the table. This piece is cut down at each end to allow the milling cutter to pass over, and ⅜-in. holes, equally spaced, are drilled for the tube cutters; ¼-in. set screws are used to hold the cutters in place. The jig will accommodate a number of cutters, according to the travel of the machine table. A 5/8-in. drill rod is used for making the cutters and only two operations on jig are required. After the first operation the cutters are turned 90 deg. and the second operation finishes them. This has proved to be a much cheaper and more efficient method than was formerly used here.

CARBOY HOLDER

A simple inexpensive stand for a carboy, used in the locomotive paint shop of the Chicago & North Western at Clinton, Iowa, is shown in the accompanying illustration. It consists of a steel plate to which are bolted the supports for the frame holding the carboy. This frame is made up of small iron strips, one surrounding the carboy and two riveted to it and passing underneath forming a sort of basket. Two



Carboy Holder

pins are riveted to the circular strip which rest on the supports, thus permitting the carboy to be tipped for emptying. A wire passing around the neck of the carboy and held by two other wires extending from it to the strip surrounding the carboy prevents it from falling out when it is tilted to an extreme position.

CARE OF BOILER TUBES

By JOSEPH SMITH

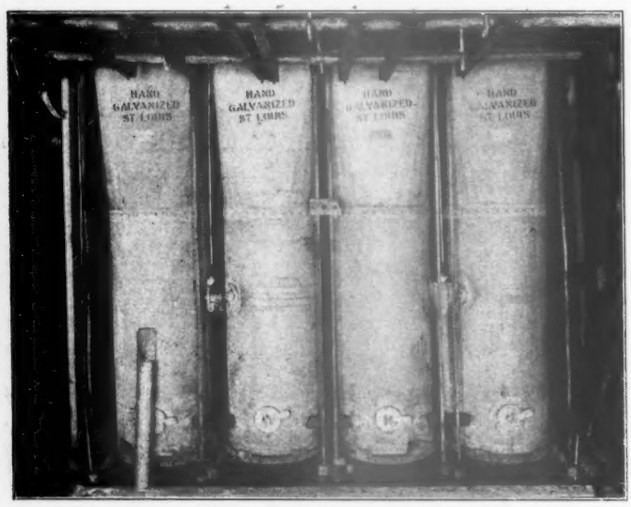
While the advent of the electric welder has aided in overcoming, to some extent, the trouble due to leaky tubes, we still have many cases arising. The scale that is formed on the end in the process of swaging is loosened in the process of expanding and as there is no avenue of escape, it remains between the tube and the copper ferrule and must be a great contributing factor to the leakage of tubes. Filing or otherwise cleaning the ends of tubes before applying will relieve this. In order to have a tight joint, we must have a clean, smooth joint.

The Prosser expander is a most useful tool, but care and good judgment should be exercised in its use. A tube can be expanded to such an extent as to reduce its elasticity, then there is no response to efforts to keep it tight. To substantiate the claim that this tool is abused I will cite an instance where a new tube sheet had been applied. It was carefully trammed just below the bottom tube at the center row and as near to the top flange as we could get. After the tubes were applied this distance was checked up, and was found to be greater by 3-16 in., showing that tubes and tube sheet had suffered by careless expanding.

New Devices

REFRIGERATOR CAR BRINE TANK VALVE

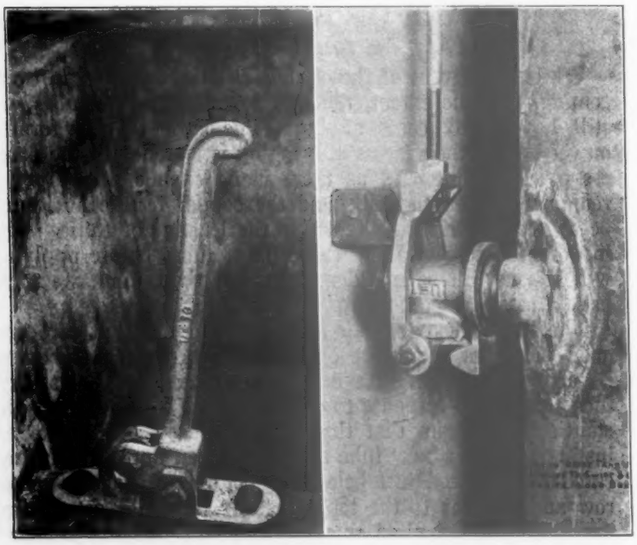
The dripping of the salt brine from refrigerator cars on the right-of-way is injurious to steel bridge construction, etc., and for this reason about two years ago, the Master Car Builders' Association ruled that all cars equipped with brine carrying tanks should also be equipped with a device for



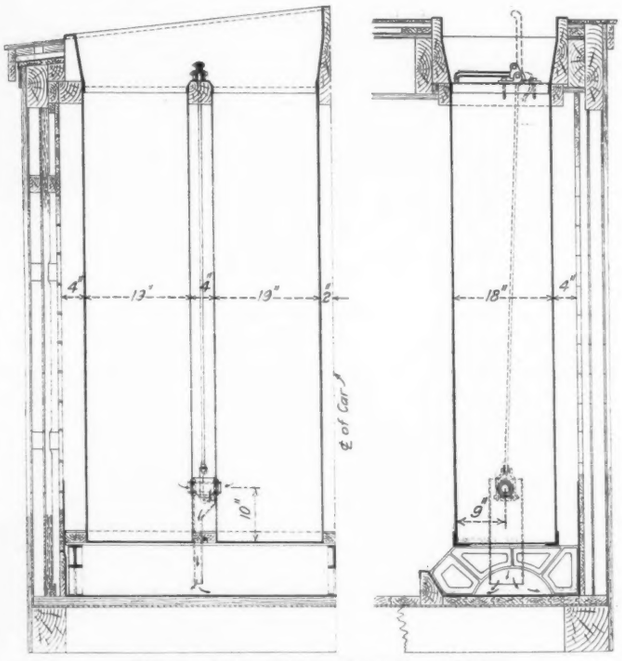
Ureco Brine Tank Valves Applied to a Beef Car

retaining the brine until the cars reached an icing station, or one of the plants of the packers, where the brine could be released and fresh brine put in the tanks.

After going into this matter thoroughly and making exhaustive tests, the Union Railway Equipment Company, McCormick Building, Chicago, has designed and placed in service a device which accomplishes the results contemplated by the M. C. B. rule. This device is known as the Ureco brine tank valve and one of the illustrations shows the application to cars equipped with square tanks, one valve draining two tanks. The valve is operated with a lever in the hatchway and to open the valve requires only the raising of the lever to a vertical position. This moves the operating rod downward, opening the gate at the lower side of the valve, which allows the brine to drain freely through the downspout, or to the pan and thence out through the traps. When the valve is open and the lever in a vertical position, it prevents the application of the hatch-plug until the valve is closed, thereby insuring the closing of the valve before the car is again in transit. The operating rod is arranged with a square nut in the clevis operating the gate, so that any variation in the distance between the top of the partition between the tanks and the tank valve can be taken up and



Operating Lever and Brine Tank Valve Applied to a Beef Car



Details of Application of the Ureco Valve

retain a water-tight connection between the gate and the valve.

All parts of the mechanism are galvanized. The valve gate in closing brings in contact two rubber seats which make water-tight condition. Conducting the brine from the valve to the pan with the downspout prevents any possibility of splashing of the brine out onto the floor of the car. Included among the illustrations are some which show the application of the Ureco brine valve to a circular design of tank, the valve being located 30 in. from the bottom of the tank and the brine carried away with a circular downspout. The valve in this instance is applied with one blind end, the blind end being held in position by a small bracket on

the adjacent tank, all four tanks being connected at the bottoms with a flexible connection.

The valve can be applied to tanks of any description and requires but 4 in. spacing between the tanks. The construction is such that little attention is required to keep it in operation.

A STEAM FLOW METER

The measurement of steam flow is one of the most difficult engineering problems that has ever been attempted. It resolves itself into two distinct parts: first, to obtain a pressure difference that varies in a known and definite manner with the rate of flow, and second, to accurately measure, record and integrate the rate of flow by means of this pressure difference. After a large amount of experimental work, in which a number of means of securing the required pressure difference were tried, the Bailey Meter Company, Boston, Mass., has developed a special type of orifice which has shown a constant accuracy over long periods. It has the additional advantages of low cost and ease of installation. The size of the orifice is properly proportioned to the size of the pipe and the meter capacity so that the Bailey standard recorder may be used from the highest to the lowest velocities without changing the piping in any way.

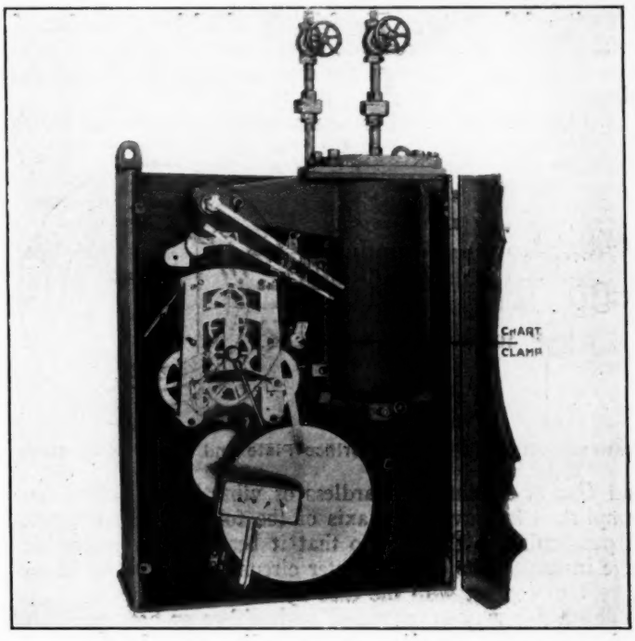
This meter works upon the principle of accurately measuring the pressure difference across an orifice placed between a pair of flanges in a pipe line, as shown in one of the illustrations. The special orifice plate is made of 1/32-in. Monel metal and is corrugated near its outer edge so that it forms its own gasket without any other packing and does not change the dimensions of the joint in any way. The size of the

Bailey Fluid Meter with Pressure and Temperature Recording Pens

orifice is proportioned to the size of the pipe, the quantity and density of steam or other fluid flowing through it, so that about one-half pound drop in pressure is secured at average rates of flow. With this small pressure drop no cutting action occurs and the orifice plate is entirely free from corrosion. Plates which have been removed after more than a year's constant service in high velocity steam lines are said to have shown no wear whatever.

A sectional view of an orifice installed in a horizontal pipe is shown in the drawing. This is of segment shape which is used in high velocity work to secure the correct pressure difference without undue obstruction. Circular orifices of relatively smaller diameter are used for lower capacities. In such cases a small drain hole is located in the orifice plate at the bottom of a horizontal steam pipe to prevent any accumulation of water.

There are but two moving parts in the recording portion of this meter and they are not subjected to the direct action of the steam, hot gases or other fluid being metered. The pressure difference is applied to opposite sides of a special shaped bell sealed in mercury, which acts as a frictionless piston, using the buoyant action of the mercury on the walls



Interior of the Meter Showing the Bell Casing and Recording Mechanism

of the bell to balance the force due to the pressure difference. The bell has a variable cross sectional area so designed that the recorder gives a reading which varies in direct proportion to the rate of flow. Charts with uniform graduations are used and the records can be easily read and averaged or totaled with a radiimeter. There are no springs, diaphragms, flexible connectors, etc., in the recorder.

When metering steam it is necessary to have the bell casing and connecting pipes completely filled with water up to an equal and constant level. Each time the bell rises or falls some water is drawn down in one pipe and an equal volume forced up in the other. It is practically impossible to have large enough reservoirs on a level with the steam pipe connections to answer this purpose, but the radiators shown in the drawing, consisting of a horizontal piece of half-inch copper pipe with a number of washers or fins, serve to maintain a uniform water level, and at substantially equal temperatures, in the two connecting pipes.

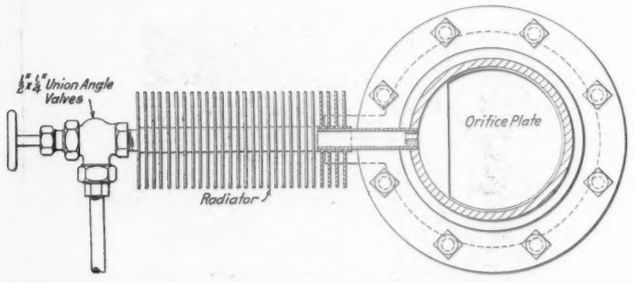
An extension of the bell casing contains the lever which operates the recording pen and integrator. One end of this lever is forked and engages two pins near the top of the bell: the other end is attached to a spindle which is given a rotary motion by the movements of the bell. This spindle has ends of small diameter which pass through pressure-tight bearings in the walls of the casing and to which are attached the pen and integrator arms. The packing is a thin disc of pliable material having a hole of the right diameter to make a practically frictionless joint which is free from leakage. The gland is so constructed that the packing is not

squeezed against the spindle when the nut is tightened.

The meter is provided with simple automatic shut-offs which prevent blowing out the mercury or otherwise damaging the apparatus when either of the pressures is excessive due to an abnormally high rate of flow, improper opening of the valves or even the breaking of one of the connecting pipes.

The counter is suspended from a knife-edge bearing on the clock frame and is moved across the disc by a connecting rod from an arm which projects down from the back end of the shaft carrying the recording pen. The follower wheel of the integrator is in frictional contact with the clock-driven disc and is moved from the center out toward the circumference as the rate of flow increases from zero to the maximum capacity of the meter. The follower wheel has a number of rollers on its circumference so as to cause practically no friction as it is moved across the disc, and also to prevent the aluminum disc from wearing smooth.

Perfect contact is said to be maintained between the wheel



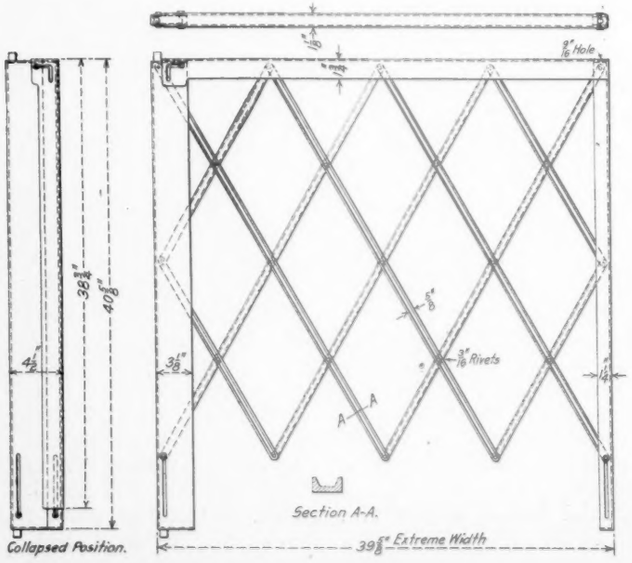
Sectional View of Pipe with Orifice Plate and Meter Connections

and disc at all times, regardless of vibration. This is accomplished by having the axis of the follower wheel almost perpendicular to the disc so that it bears on its projecting edge instead of its extreme outer circumference. The wheel is held in contact with the disc by a cantilever spring.

The meter may be provided with either or both pressure and temperature recording pens recording near the center of the chart and which are operated by the well known Bristol or Foxboro helical tubes, connected respectively to the arm of the bell-casing and a thermometer bulb in the steam line.

ACME FOLDING TAIL GATE

The Acme Supply Company, Chicago, has placed on the market a new type of folding tail gate for passenger train



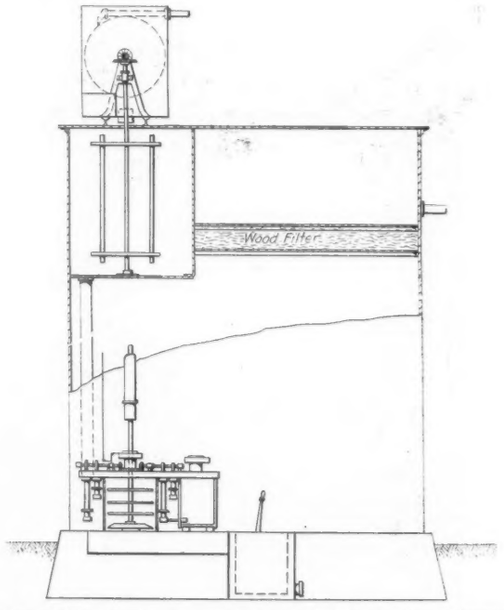
Folding Tail Gate in Open and Closed Positions

cars. This gate has several desirable features. It is light, strong and has a neat appearance in both the open and closed position. It is provided with a pressed steel housing at the left, a top guard rail which also forms a cover to the housing when the gate is folded, and a pressed steel end post. The lattice work is made of channel sections to give sufficient strength with minimum weight. When the gate is folded it is completely encased and can be folded against the vestibule diaphragm post allowing the vestibule curtain to be pulled into position, covering the tail gate from view when it is not in service. This design of gate has no projections and eliminates the possibility of the clothing of the passengers being caught. The gates are furnished with the necessary brackets and a brass plunger pull pin is provided for locking when in the service position. The gates can be made to interchange with the type of brackets now used on cars in service.

WATER SOFTENER WITH INCREASED SETTLING SPACE

A water softening plant has recently been brought out by the L. M. Booth Company, New York, in which the relation of the softening chamber to the settling and storage tank has been changed to provide a maximum area of upward flow through the latter, facilitating the settling of the precipitate.

In the usual type of construction of these plants the softening tank extends down into the settling space through practically its entire depth, the water and chemical supply entering at the top and as it gradually flows downward being thoroughly stirred mechanically. On leaving the softening tank, at the bottom, the water gradually rises in the settling space while the precipitate collects at the bottom of the set-



Booth Water Softener with Segmental Softening Chamber

tling tank. With the softening tank thus located, the effective area of the settling space is considerably less than the total cross sectional area of the settling tank. Consequently the rate at which the water rises is faster than would be the case were the entire area available, and the settling of the precipitate is slower.

In the newly designed plant the softening tank occupies a segment of the storage tank near the top, thus leaving practically the entire area of the settling tank available for the upward flow of the water which is conveyed from the softening chamber through vertical pipes opening near the bottom of the settling tank.

Railway Mechanical Engineer

(Formerly the RAILWAY AGE GAZETTE, MECHANICAL EDITION *with which the* AMERICAN ENGINEER *was incorporated)*

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The steamers Massachusetts and Bunker Hill, of the Metropolitan Line, running between New York and Boston, now pass through the Cape Cod Canal, thus shortening their journey 77 miles. The Cape Cod canal, eight miles long, was opened two years ago, with a depth of water of 15 feet. One year ago it had a depth of 18 feet.

The London & North-Western has discontinued the running of restaurant and dining cars on its entire system of over 3,000 miles. The Great Western is taking off restaurant cars on the routes to Birmingham and the north, and it is supposed that other railway companies will also discontinue the use of dining cars on the ground of economy.

The Norfolk & Western has notified employees that, except where important interests of the company may interfere, anyone who wishes to take his vacation this year at Camp Oglethorpe, Ga., for military training, will be allowed a month off, with pay; this is an experiment to see how the matter works out. The company believes that large employers of men ought to encourage military training; but, of course, can reach no satisfactory conclusion until it is seen how many men desire to go to the camps. According to the Knoxville Sentinel, somebody expects that 500 employees of the road will go to Fort Oglethorpe; but an officer of the company informs us that, for the May encampment, only two took advantage of the company's offer; one a man from the general office, and the other a conductor on the Norfolk division. There is to be another encampment in June.

THE JUNE CONVENTIONS

The chairman of the entertainment committee of the Railway Supply Manufacturers' Association, Gilbert E. Ryder, Locomotive Superheater Company, New York, reports that arrangements are being made to re-establish the baseball game on Saturday afternoon. This year the teams will represent the two railroad associations; that is, the game will be played by teams representing respectively the Master Car Builders' and the Master Mechanics' associations. The teams are now being organized by M. C. M. Hatch, supervisor of fuel service of the Delaware, Lackawanna & Western, who will manage the Master Mechanics' team, and A. La Mar, master mechanic of the Pennsylvania Lines West, at Chicago, who will manage the Master Car Builders' team. Provisions are also being made for the best golf tournament

that the conventions have ever had. The arrangements are under the direct supervision of E. H. Bankard, Jr., Cambria Steel Company, Chicago, acting for the entertainment committee.

ORDERS FOR CARS AND LOCOMOTIVES IN MAY

The large buying of locomotives still continues, the orders for locomotives reported during May totaling 278, including 30 engines for export. The orders for freight and passenger cars reported during the month, on the other hand, were rather disappointing, orders for only 3,154 freight cars and 33 passenger cars for domestic service having been noticed. The totals for the month were as follows:

	Locomotives	Freight cars	Passenger cars
Domestic	248	3,154	33
Foreign	30	3,050	..
	278	6,204	33

Among the important locomotive orders were the following:

Road	No.	Type	Builder
Boston & Maine	25	Switching	American
	25	Consolidation	American
	10	Pacific	American
Canadian Government Rys.	30	Mikado	Canadian
Denver & Rio Grande	10	Santa Fe	American
Maine Central	6	Mikado	American
	2	Switching	American
Pennsylvania (Lines East)	75	Mikado	Baldwin
Seaboard Air Line	5	Mountain	American
Southern	6	Mikado	Lima
	8	Switching	Lima
Temiskaming & Northern Ontario	6	Mikado	Canadian
Terminal Ass'n of St. Louis	12	Switching	American
Paris-Lyons-Mediterranean (France)	20	Mikado	Baldwin

The freight car orders included 1,000 wooden box cars ordered by the Chicago & North Western from the American Car & Foundry Company. The Canadian Government Railways ordered 500 box cars from the Eastern Car Company and 500 from the Canadian Car & Foundry Company. The Louisville & Nashville has ordered its own shops to build 1,000 box, 500 gondola and 100 furniture cars.

Of the 33 passenger cars, 20 were ordered by the Norfolk & Western from Harlan & Hollingsworth Corporation. The order included 7 coaches, 6 baggage and express cars, 4 baggage and mail cars and 3 postal cars.

MONUMENT TO THE LEXINGTON & OHIO

F. Paul Anderson, dean of the College of Mechanical & Electrical Engineering of the State University of Kentucky, Lexington, announces that on Tuesday, May 30, the college proposes to dedicate at Lexington a monument to early American railroading; the monument to be in the shape of a section of the original track of the Lexington & Ohio Railroad, the first railroad built west of the Allegheny mountains. About 25 feet of the original track, made up of materials which have recently been unearthed, will be set in a concrete base on the campus of the university, and with it a bronze tablet bearing the following inscription:

> This restoration of a portion of the original track of the Lexington and Ohio (now Louisville and Nashville) Railroad, laid at Lexington in 1831, is dedicated to those men of forethought and courage who were pioneers in railroad development in America.
>
> Erected Anno Domini
> MCMXVI.

The sleepers of this track consisted of longitudinal stone "sills," and the rails were of wrought iron, half an inch thick, three inches wide and 14 feet long. The ends of the rails were miter jointed and were secured by spikes driven into lead-filled holes which had been drilled in the stone. Railroad officers and everybody interested will be welcomed at the dedication.

Professor V. E. Muncy has gathered a large amount of interesting history of the old railroad which is to be celebrated. The first stone sill was laid October 21, 1831, and the railroad was opened August 12, 1832. The cars were drawn by horses. In March, 1833, a length of six miles was in operation, and the "car, usually filled with passengers, was run regularly three times a day, each way." About this time a steam locomotive, built by a Mr. Bruen, was in use; and on January 31, 1835, "an elegant new locomotive of improved model" was running between Lexington and Frankfort. About a year later, as appears from newspaper accounts, horses were again put in use for hauling the passenger cars, the locomotive being not sufficiently reliable for passenger service. It was, however, continued in use for hauling freight cars.

The average annual receipts of the road for passenger and freight transportation during four and one-half years, ending in 1847, were $45,940; average annual profits, $20,650.

MEETINGS AND CONVENTIONS

Chief Interchange Car Inspector's and Car Foreman's Association.—The annual convention of the Chief Interchange Car Inspector and Car Foreman's Association will be held in Indianapolis, Ind., October 3, 4 and 5, 1916.

The Traveling Engineers' Association.—The next annual convention of The Traveling Engineers' Association will be held on September 5-8, at Chicago, Ill. The following is a list of the subjects to be discussed at this meeting: Stoking and Lubricating, and Their Effect on the Cost of Locomotive Operation; Superheaters and Brick Arches on Large Locomotives; The Prevention of Smoke and Its Relation to the Cost of Fuel and Locomotive Repairs; Recommended Freight Train Practice; Assignment of Power from the Standpoints of Efficient Service and Economy in Fuel and Maintenance.

American Society for Testing Materials.—The nineteenth annual meeting of the American Society for Testing Materials will be held at Atlantic City, N. J., June 27 to 30. Headquarters for the meeting will be at the Hotel Traymore. A summarized program of the meeting follows:

First session, Tuesday, June 27, 11 a. m.—Minutes of eighteenth annual meeting; report of executive committee; various committee reports; announcement of election of officers; miscellaneous business.

Second session, Tuesday, 3 p. m.—Reports of committees on miscellaneous materials.

Third session, Tuesday, 8 p. m.—Presidential address and reports on heat treatment of steel.

Fourth session, Wednesday, 10 a. m.—Reports on steel and iron.

Wednesday afternoon will be reserved for recreation.

Fifth session, Wednesday, 8 p. m.—Reports on tests and testing.

Sixth session, Thursday, 10 a. m.—Reports on cement and concrete.

Seventh session, Thursday, 3 p. m.—Reports on ceramics and road materials.

Thursday evening will be reserved for a smoker.

Eighth session, Friday, 10 a. m.—Reports on non-ferrous metals and cast iron.

Ninth session, Friday, 3 p. m.—Reports on miscellaneous materials.

The nominating committee has agreed to the following selections: For president, A. A. Stevenson; for vice-president, S. S. Voorhees; for members of the executive committee, W. H. Bassett, John Brunner, G. W. Thompson and F. E. Turneaure.

The M. C. B. and M. M. Conventions.—The program of the convention of the Master Car Builders' Association at Atlantic City, beginning June 14, includes the presentation of committee reports of the standing committees on Arbitration, Standards and Recommended Practice; Train Brake and Signal Equipment; Brake Shoe and Brake Beam Equipment; Couplers; Loading Rules; Car Wheels; Safety Appliances; Car Construction, and Specifications and Tests for Materials. Reports will be received from the special committees on Car Trucks; Prices for Labor and Material; Train Lighting and Equipment; Tank Cars; Settlement

Prices for Reinforced Wooden Cars; Draft Gear, and Welding of Truck Side Frames and Bolsters.

At the convention of the Master Mechanics' Association, beginning June 19, committee reports will be presented by the standing committees on Standards and Recommended Practice; Mechanical Stokers, and Fuel Economy and Smoke Prevention; and by the special committees on Design and Maintenance of Locomotive Boilers; Locomotive Headlights; Superheater Locomotives; Equalization of Long Locomotives; Dimensions of Flange and Screw Couplings for Injectors; Design, Maintenance and Operation of Electric Rolling Stock; Best Designs and Materials for Pistons, Valves, Rings and Bushings; Co-operation with Other Mechanical Organizations; Powdered Fuel; Specifications and Tests for Materials; Train Resistance and Tonnage Rating, and Modernizing of Existing Locomotives.

The chairman of the entertainment committee of the Railway Supply Manufacturers' Association announces that euchre parties for the ladies will be held Thursday and Tuesday. The ladies' committees in charge have Mrs. D. R. McBain as chairman the first week, and Mrs. E. W. Pratt as chairman for the second week. Prizes will be offered. Players will be identified by their badge numbers.

The president of the Railway Supply Manufacturers' Association, Oscar F. Ostby, announces that the executive office of the association will be opened on the pier May 29, at which time certain spaces will be ready for the installation of exhibits. According to official circular No. 2, exhibit booths will be ready for occupancy as follows: Exhibition Hall, May 29; under west balcony of Main Building, June 9; all others June 6, except spaces on runways used for trucking, which spaces will be available in ample time. The pier authorities have advised that preparations are progressing excellently, and that everything will be ready four or five days in advance. All exhibitors are urged to get their exhibits on the way as soon as possible, so that there may be no danger of delay because of the freight congestion.

The following list gives names of secretaries, dates of next or regular meetings and places of meeting of mechanical associations:

AIR BRAKE ASSOCIATION.—F. M. Nellis, Room 3014, 165 Broadway, New York City.

AMERICAN RAILROAD MASTER TINNERS', COPPERSMITHS' AND PIPEFITTERS' ASSOCIATION.—W. E. Jones, C. & N. W., 3814 Fulton St., Chicago.

AMERICAN RAILWAY MASTER MECHANICS' ASSOCIATION.—J. W. Taylor, Karpen Building, Chicago. Convention, June 19, 1916, Atlantic City, N. J.

AMERICAN RAILWAY TOOL FOREMEN'S ASSOCIATION.—Owen D. Kinsey, Illinois Central, Chicago. Convention, August 24-26, 1916.

AMERICAN SOCIETY FOR TESTING MATERIALS.—Prof. E. Marburg, University of Pennsylvania, Philadelphia, Pa. Convention, June 27-30, Traymore Hotel, Atlantic City, N. J.

AMERICAN SOCIETY OF MECHANICAL ENGINEERS.—Calvin W. Rice, 29 W. Thirty-ninth St., New York.

ASSOCIATION OF RAILWAY ELECTRICAL ENGINEERS.—Joseph A. Andreucetti, C. & N. W., Room 411, C. & N. W. Station, Chicago. Semi-annual meeting, Hotel Denis, Atlantic City, N. J., June 16.

CAR FOREMEN'S ASSOCIATION OF CHICAGO.—Aaron Kline, 841 Lawlor Ave., Chicago. Second Monday in month, except June, July and August, Hotel La Salle, Chicago.

CHIEF INTERCHANGE CAR INSPECTORS' AND CAR FOREMEN'S ASSOCIATION.—W. R. McMunn, New York Central, Albany, N. Y. Convention, October 3-5, Indianapolis, Ind.

INTERNATIONAL RAILWAY FUEL ASSOCIATION.—J. G. Crawford, 547 W. Jackson Blvd., Chicago.

INTERNATIONAL RAILWAY GENERAL FOREMEN'S ASSOCIATION.—William Hall, 1126 W. Broadway, Winona, Minn. Convention, August 29-31, 1916, Hotel Sherman, Chicago.

INTERNATIONAL RAILROAD MASTER BLACKSMITHS' ASSOCIATION.—A. L. Woodworth, Lima, Ohio. Convention, August 15-17, 1916, Hotel Sherman, Chicago.

MASTER BOILER MAKERS' ASSOCIATION.—Harry D. Vought, 95 Liberty St., New York.

MASTER CAR BUILDERS' ASSOCIATION.—J. W. Taylor, Karpen Building, Chicago. Convention, June 14, 1916, Atlantic City, N. J.

MASTER CAR AND LOCOMOTIVE PAINTERS' ASSOCIATION OF U. S. AND CANADA.—A. P. Dane, B. & M., Reading Mass. Convention, September 12-14, 1916, "The Breakers," Atlantic City, N. J.

NIAGARA FRONTIER CAR MEN'S ASSOCIATION.—E. Frankenberger, 623 Brisbane Building, Buffalo, N. Y. Meetings, third Wednesday in month, New York Telephone Bldg., Buffalo, N. Y.

RAILWAY STOREKEEPERS' ASSOCIATION.—J. P. Murphy, Box C, Collinwood, Ohio.

TRAVELING ENGINEERS' ASSOCIATION.—W. O. Thompson, N. Y. C. R. R., Cleveland, Ohio. Convention, September 5-8, 1916, Chicago.

PERSONAL

GENERAL

C. D. BARRETT has been appointed assistant engineer of motive power of the Pennsylvania Railroad at Altoona, Pa. Mr. Barrett was born on January 25, 1881, and graduated from Purdue University in 1901. He entered the service of the Pennsylvania Railroad in July, 1901, as special apprentice at Altoona, Pa. In March, 1905, he was appointed inspector in the machine shop and later in that year was transferred to Jersey City, N. J., in the same capacity. In May, 1907, he was appointed assistant master mechanic at Camden, N. J., and in April, 1908, he returned to Jersey City as inspector. He was promoted to foreman at State Line, Pa., in November, 1908, and in April, 1909, was made assistant master mechanic at Wilmington, Del. In May, 1911, he was promoted to assistant engineer of motive power at Williamsport, Pa., which position he held at the time of his recent appointment at Altoona, as noted above.

H. H. MAXFIELD, whose appointment to the position of superintendent of motive power of the Western Pennsylvania division of the Pennsylvania Railroad was announced in our last issue, has been in the service of the Pennsylvania Railroad since 1895, and a master mechanic on the Pittsburgh division since 1905. He was born in 1873 and was educated at Stevens' Institute. He entered the service of the Pennsylvania Railroad September 5, 1895. He became a machinist August 1, 1899, and March 1, 1900, became inspector or gang leader. On April 1, 1901, he was appointed assistant road foreman of engines, becoming successively on December 1, 1902, assistant master mechanic, and on April 15, 1903, assistant engineer of motive power. On April 1, 1905, he became master mechanic of the Pittsburgh division, and it is this position he now leaves to take up his new duties as superintendent of motive power of the Western Pennsylvania division, with office at Pittsburgh.

H. H. Maxfield

H. D. CAMERON, whose appointment as mechanical engineer of the Canadian Northern, with office at Toronto, Ont., was announced in our May issue, was born on September 23, 1879, at Toronto, and was educated in Montreal public and high schools, and in 1901 graduated from McGill University with the degree of B. S. He began railway work in the summer of 1899, as a mechanical apprentice at the Grand Trunk shops, Montreal, Que., and continued in shop work during vacations and after graduation until 1902. He subsequently worked for about one year in the mechanical department drawing office at Ottawa, Ont., of the Canada Atlantic, now a part of the Grand Trunk. From 1903 to 1905 he was assistant engineer of the Montreal Water & Power Company, and then joined the engineering staff of the Gulf, Colorado & Santa Fe at Cleburne, Tex. In 1906 he returned to Canada and entered the service of the Canadian Northern in the mechanical department at Winnipeg, and in April, 1916, was transferred to Toronto as mechanical engineer of the same road, as above noted.

L. B. JONES has been appointed assistant engineer of

motive power of the Central division of the Pennsylvania Railroad at Williamsport, Pa. Mr. Jones was born in September, 1882, at West Grove, Pa. He graduated from Cornell University in 1904, and entered the service of the Pennsylvania Lines West as a special apprentice in July of that year. He was made locomotive fireman in November, 1906, and in February, 1907, became enginehouse foreman at Logansport, Ind. He was appointed assistant electrician at Columbus, Ohio, in July, 1908, and in March, 1910, was made electrician of the Vandalia Railroad. In February, 1911, he was made inspector at Columbus, Ohio, and in January, 1913, was promoted to assistant engineer of motive power of the Central system, Lines West, and was transferred to the Southwest system in the same capacity in June, 1915, which position he held at the time of his recent appointment as noted above.

THOMAS LEWIS, whose appointment as general boiler inspector of the Lehigh Valley at Sayre, Pa., was announced in our May issue, was employed respectively by the Chicago & Alton, Bloomington, Ill.; Vandalia, Terre Haute, Ind.; Chicago & North Western, Chicago, and for five years was assistant foreman boiler maker of the Union Pacific at Omaha, Neb. He entered the service of the Lehigh Valley as general boiler foreman of the shops at Sayre, Pa., in January, 1907, and was promoted to general foreman in October, 1912. He was made master mechanic of the Auburn division in January, 1916, and was promoted to general boiler inspector in April last.

MASTER MECHANICS AND ROAD FOREMEN OF ENGINES

ROBERT G. BENNETT has been appointed assistant master mechanic of the Cumberland Valley at Chambersburg, Pa. Mr. Bennett entered the service of the Pennsylvania Railroad as an apprentice in the Erie, Pa., shops in January, 1900, and in 1902 was transferred to the Renovo shops where he completed his course in 1904. He then entered Purdue University, taking the course in mechanical engineering, from which he graduated in 1908 and received his degree of mechanical engineer in 1915. In 1908 he was appointed motive power inspector of the Monongahela division of the Pennsylvania and was made rodman in the maintenance of way department of the Pittsburgh division in 1912. He was transferred to the test department at Altoona as inspector in 1913, which position he held up to the time of his recent appointment as assistant master mechanic of the Cumberland Valley, as noted above.

A. BROWN, formerly district master mechanic of the Canadian Pacific at Winnipeg, has been appointed district master mechanic, district 1, British Columbia division, at Revelstoke, B. C., succeeding W. J. Renix, transferred.

M. G. CHARLES, master mechanic of the Oregon Electric and the United Railways, at Portland, Ore., has had his jurisdiction extended over the Portland division of the Spokane, Portland & Seattle.

T. H. HAMILTON has been appointed district master mechanic, districts 1, 3 and 4, Ontario division of the Canadian Pacific at Toronto, Ont., succeeding G. I. Evans.

FREDERICK W. HANKINS, who has recently been appointed master mechanic of the Cumberland Valley at Chambersburg, Pa., was born on January 1, 1876, at London, England. Mr. Hankins was educated in the public schools of Foxburg, Pa., and entered the service of the Pittsburgh & Western, then part of the Baltimore & Ohio, as machinist apprentice in April, 1891. He was transferred to the Baltimore & Ohio at Allegheny, Pa., in 1894, and in July, 1897, entered the employ of the Allegheny Valley at the Forty-third street shops in Pittsburgh, Pa., where he served successively as machinist, leading machinist, and acting roundhouse foreman until April, 1905, when he was transferred to the Cumberland Valley as enginehouse foreman at Chambersburg, Pa. In January, 1907, he was appointed machine shop foreman at Chambersburg, Pa., and in December, 1910, was promoted to general foreman of the Chambersburg shops, which position he held until his new appointment as master mechanic, as noted above.

J. M. KERWIN has been appointed master mechanic of the Dakota division of the Chicago, Rock Island & Pacific, with office at Estherville, Iowa, succeeding W. B. Embury, transferred.

T. F. PHELAN has been appointed road foreman of equipment of the Chicago, Rock Island & Pacific at Herington, Kan., succeeding B. J. Bonner, transferred.

CHARLES D. PORTER has been appointed master mechanic of the Pennsylvania Railroad at Pittsburgh, Pa. Mr. Porter was born on February 7, 1883, at Fort Wayne, Ind., and graduated from Purdue University in 1902. In July, 1900, he entered the service of the Pennsylvania Lines West, and in July, 1902, was made special apprentice. He was appointed motive power inspector at Buffalo in June, 1906, and was made enginehouse foreman at Driftwood in August, 1908. In April, 1909, he was appointed foreman of the Mifflin shops and in October of that year was transferred to the Park shops, remaining there until January, 1912, when he was promoted to assistant general foreman of the Pitcairn car shops. He was made assistant master mechanic at Pittsburgh in December, 1912, and was appointed assistant engineer of motive power at Altoona in July, 1913, which position he held until May, 1916, when he was promoted to master mechanic at Pittsburgh.

W. J. RENIX, formerly district master mechanic, district 1, British Columbia division of the Canadian Pacific at Revelstoke, has been appointed district master mechanic at Moose Jaw, Sask.

F. W. SADLIER, formerly shop foreman of the Canadian Pacific at Revelstoke, B. C., has been appointed district master mechanic at Fort William, Ont., succeeding G. Twist, transferred.

G. TWIST, formerly district master mechanic of the Canadian Pacific at Fort William, Ont., has been appointed district master mechanic at Winnipeg, succeeding A. Brown, transferred.

CAR DEPARTMENT

W. H. LONG, formerly car foreman of the Canadian Northern at Trenton, Ont., has been appointed general car foreman of the Ontario division at Toronto, Ont.

C. N. MCMATH has been appointed car inspector of the Grand Trunk Pacific at Transcona, Man., succeeding N. C. Hooper.

SHOP AND ENGINE HOUSE

W. J. BARBER, formerly acting locomotive foreman of the Canadian Pacific at North Bend, B. C., has been appointed locomotive foreman at Revelstoke, B. C., succeeding F. D. Warner, transferred.

N. B. CORBETT has been appointed shop superintendent of the Missouri, Kansas & Texas, at Denison, Tex., succeeding B. C. Nicholson.

R. A. HUEY has been appointed general locomotive foreman of the Chicago, Rock Island & Pacific at Armourdale, Kan.

G. C. GIBSON, formerly locomotive foreman of the Canadian Pacific at Strathcona, Alta., has been appointed locomotive foreman at Saskatoon, Sask., succeeding C. A. Perry, transferred.

J. W. JACKSON, formerly locomotive foreman of the Canadian Pacific at Rogers Pass, B. C., has been appointed locomotive foreman at Kamloops, B. C., succeeding John Macrae.

JAMES MCGOWN, JR., formerly machinist of the Canadian Pacific, has been appointed locomotive foreman at Rogers Pass, B. C., succeeding J. W. Jackson, transferred.

R. A. MCPHERSON has been appointed locomotive foreman of the Canadian Pacific at Ignace, Ont., succeeding A. J. Pentland, transferred.

A. W. MARTIN has been appointed superintendent of shops of the Cleveland, Cincinnati, Chicago & St. Louis, at Beech Grove, Ind., succeeding R. J. Williams, resigned.

S. E. MUELLER has been appointed general foreman locomotive shops of the Chicago, Rock Island & Pacific at Cedar Rapids, Iowa, succeeding J. M. Kerwin, promoted.

J. D. MUIR, formerly locomotive foreman of the Canadian Pacific at Medicine Hat, Alta., has been appointed locomotive foreman at Winnipeg, succeeding G. Pratt, transferred.

A. J. PENTLAND, formerly locomotive foreman of the Canadian Pacific at Ignace, Ont., has been appointed locomotive foreman at Souris, Man., succeeding H. J. Reed, transferred.

C. A. PERRY, formerly locomotive foreman of the Canadian Pacific at Saskatoon, Sask., has been appointed locomotive foreman at Medicine Hat, Alta., succeeding J. D. Muir, transferred.

G. PRATT, formerly locomotive foreman of the Canadian Pacific at Winnipeg, Man., has been appointed locomotive foreman at Strathcona, Alta., succeeding G. C. Gibson, transferred.

R. QUINN, formerly in Winnipeg shops of the Canadian Pacific, has been appointed shop foreman at Revelstoke, B. C., succeeding F. W. Sadlier, transferred.

J. A. REID, formerly locomotive foreman of the Canadian Pacific at Souris, Man., has been appointed locomotive foreman at Cranbrook, B. C., succeeding D. G. MacDonald.

JOHN R. SWINDELL has been appointed superintendent of the Wyoming Shops of the Pere Marquette at Grand Rapids, Mich., succeeding C. S. Williams, resigned.

F. D. WARNER, formerly locomotive foreman of the Canadian Pacific at Revelstoke, B. C., has been appointed locomotive foreman at Nelson, B. C., succeeding W. Pitts.

F. L. WILLIS has been appointed night locomotive foreman of the Canadian Northern at Dauphin, Man.

PURCHASING AND STOREKEEPING

SAMUEL WILSON SAYE, recently appointed purchasing agent of the Georgia & Florida, with headquarters at Augusta, Ga., was born on August 4, 1893, at Athens, Ga. He was educated in the grammar schools and later took a commercial course; then for two years received private instruction at Augusta. On January 8, 1912, he began railway work as a stenographer on the Southern Railway at Columbia, S. C. The following April he entered the service of the Georgia & Florida as a stenographer in the accounting department, and three months later he became secretary to the general manager. On February 1, 1916, he was appointed commercial agent, with headquarters at Vidalia, Ga., which position he held at the time of his recent appointment as purchasing agent of the same road at Augusta.

R. O. WOODS has been appointed division storekeeper of the Mobile & Ohio, with office at Meridian, Miss., succeeding M. R. Ducey, resigned to accept service with another company.

SUPPLY TRADE NOTES

The Acme Supply Company has removed its general sales offices to larger quarters located at 1110-1113 Steger building, Chicago.

The Goldschmidt Thermit Company, New York, has moved its offices from 90 West street to the Equitable building, 120 Broadway.

C. F. Schroeder, treasurer of the Schroeder Head Light Company, Evansville, Ind., was killed in the railroad accident at New Decatur, Ala., on Saturday, May 6.

The Southern Locomotive Valve Gear Company, Knoxville, Tenn., has recently put on the market a new power reverse gear known as the Brown power reverse gear.

The general offices of the Standard Heat & Ventilation Company in New York have been removed to rooms 1504 and 1505 in the City Investing building, at 165 Broadway.

Sherritt & Stoer Company, Inc., 603 Finance building, Philadelphia, have been appointed the exclusive sales agents of the Gardner Machine Company for the Philadelphia district.

H. L. Breckenridge, for the past three years purchasing agent of the American Locomotive Company at Montreal, has been appointed purchasing agent of the Lima Locomotive Corporation, Lima, Ohio.

J. L. Adams, sales representative of the Cambria Steel Company, at Cincinnati, Ohio, has been appointed manager of sales of the Cambria Steel Company, the Midvale Steel Company and Worth Brothers Company.

William E. Eastman, inventor of the Eastman system for heating freight cars, and the founder and president of the Eastman Car Company, Charlestown, Mass., died at his home in Winchester, Mass., on May 15, at the age of 75 years.

The Terry Steam Turbine Company, Hartford, Conn., announces the appointment of O. E. Thomas, 626 Washington building, Los Angeles, Cal., as district sales manager for a territory covering Arizona and the southern portions of California and Nevada.

J. H. McDonald, chief clerk to the superintendent of telegraph of the Pennsylvania Railroad at Philadelphia, has resigned from that position to accept the position of superintendent of transportation of the Bethlehem Steel Company, with office at Steelton, Pa.

Henry C. Hammack has been elected secretary and treasurer of the Lima Locomotive Corporation, Lima, Ohio, to succeed John H. Guess, who recently resigned. Mr. Hammack has been with the company for eighteen years, having served as general and field manager and assistant secretary.

F. L. Fay, formerly general manager of the Greenville Steel Car Company, has been elected president and now has the controlling interest in the business. James G. Dimmick is vice-president and will have charge of the production department and factory management. The company is enlarging its plant to handle more business.

The Modern Tool Company, Erie, Pa., will hereafter devote its attention to its line of self-contained internal plain and universal grinding machines. It has sold its overhead counter-shaft line of plain, internal and universal grinders to Albert J. Ott, Chicago, Ill., who will manufacture and market these machines under the name of the Ott grinders.

C. J. Wymer, general car foreman of the Belt Railway of Chicago, has resigned that position to enter the employ of the Grip Nut Company as sales agent. Mr. Wymer was born in Jane Lew, W. Va., and after leaving school served his

apprenticeship with the West Virginia & Pittsburgh, now a part of the Baltimore & Ohio system. He entered the employ of the mechanical department of the Atchison, Topeka & Santa Fe at Raton, N. M., in September, 1896. He was promoted to car foreman at Trinidad, Colo., in 1898, where he remained until 1907, when he was appointed general car foreman of the Chicago & Eastern Illinois at Danville, Ill. In 1908 he came to Chicago, Ill., to become general car foreman of the Belt.

E. T. Sawyer, who has been associated with the Commercial Acetylene Railway Light & Signal Company for over eight years, has resigned to accept a position as sales engineer with the Edison Storage Battery Company. Mr. Sawyer from about 1901 to 1904 was with the western office of the Dressel Railway Lamp Works, of New York, and the Star Brass Manufacturing Company, of Boston. He later spent four years in the employ of the Acme Ball Bearing Company as manager of the railway department. His first three years in the employ of the Commercial Acetylene Railway Light & Signal Company were spent as southern manager. For the last five years he has been connected with the main office at New York.

Clifford J. Ellis, recently appointed manager of sales of the Midvale Steel Company at Chicago, has been in the employ of the Cambria Steel Company, formerly the Cambria Iron Company, for over 37 years, starting at the Johnstown (Pa.) office in 1879. In 1885, he was transferred to the Philadelphia office with the title of general agent. In that capacity he not only had charge of the sale of steel rails throughout the country but had direct supervision of the entire sales of the New York office. In September, 1886, he was transferred to Chicago, as manager of sales, in charge of the sale of all the company's products. As manager of sales of the Midvale Steel Company he will handle the business of that company and its recently acquired subsidiaries, Cambria Steel Company and Worth Brothers Company. His headquarters will be at 458 McCormick building.

Clifford J. Ellis

John B. Kilpatrick, vice-president of the Universal Arch Company, Chicago, Ill., died in that city on May 14. Mr. Kilpatrick was born at Philadelphia, Pa., on August 9, 1862, and was educated in Baltimore, Md. He entered the service of the Chicago, Rock Island & Pacific, in 1889, as general foreman at Fairbury, Neb. From 1890 to 1893, he was general foreman of the Colorado division at Goodland, Kans. From 1893 to 1902, he was master mechanic of the Iowa division, at Valley Junction, Iowa. He was stationed at Horton, Kans., as master mechanic from 1902 to 1903, when he was appointed assistant superintendent of motive power, with office at Chicago, Ill. From 1904 to 1912, he was superintendent of motive power at Chicago, and from April 1, 1912, to August 15, 1913, was district mechanical superintendent at Davenport, Iowa, and at Des Moines. From 1913 up to the date of his death he was engaged in the railway supply business, having been elected vice-president and director of the Universal Arch Company, Chicago, on April 1, 1916.

CATALOGUES

ELECTRIC GRINDERS.—The Chicago Pneumatic Tool Company has recently issued Bulletin E-39, descriptive of the company's line of Duntley electric grinders.

STEEL.—The Vanadium-Alloys Steel Company, Latrobe, Pa., has recently issued two folders descriptive respectively of the company's Vasco non-shrinkable tool steel and its Vasco choice tool steel.

DRAWING MATERIALS.—Kolesch & Co., 138 Fulton street, New York, have issued a folder descriptive of the Security tube for protecting and storing blue print paper, tracing paper and cloth and drawing paper.

HIGH-SPEED STEEL.—The Vanadium-Alloys Steel Company, Pittsburgh, Pa., has recently issued a new folder which describes the company's Red Cut Superior high-speed steel. The pamphlet offers suggestions concerning heat treatment.

THE BRINELL METER.—Herman A. Holz, New York, has issued a ten-page booklet describing the Brinell meter for determining the hardness of metals. The book is illustrated with photographs of the testing outfit, and describes the method of operation in detail.

WHARTON SPECIALTIES.—William Wharton, Jr., & Co., Easton, Pa., have issued Bulletin No. 2, describing W-J switch stands, Wharton-O'Brien insulated switch rods and adjustable switch crank, and an insulated gage rod. The descriptions of the various devices are illustrated.

GASOLENE HOISTS.—The Lidgerwood Manufacturing Company has issued Bulletin No. 16, illustrating and describing a line of hoists operated by gasolene engines. These hoists are intended for use where electric current is not obtainable, and where coal and water suitable for boiler use are difficult to obtain.

BUILDING MATERIALS.—E. M. Long & Sons, Cadiz, Ohio, have issued an attractive 24-page booklet describing their lumber and other products, including O. G. fir gutters used extensively on railway buildings. The book is well illustrated with a large number of photographs showing various sections of their plant and their products.

PORTABLE CRANES.—The Canton Foundry & Machine Company, Canton, Ohio, has issued a booklet illustrating and describing the company's line of portable floor cranes and hoists. These cranes are so made that they can lift heavy loads and transfer them to or from lathes, planers or other machines, one man with a crane often being able to do work that would require four or more men without a crane. The cranes are in use in railroad shops for handling cylinder heads, steam chests, car wheels, large castings, etc.

TRANSVEYORS.—The Cowan Truck Company, Holyoke, Mass., has issued a booklet describing and illustrating the Cowan transveyor or elevating truck. In transferring material by means of these trucks, the material to be moved having been piled on low platforms is transported without rehandling or repiling, or, as the catalogue puts it, the Cowan transveyors "make the floor move." The booklet shows clearly how the trucks are used, by means of a number of views of trucks in use in various kinds of warehouses and shops.

OIL ENGINES.—Fairbanks, Morse & Co., Chicago, have recently issued Bulletins H 178 B and H 192 C, dealing respectively with the Fairbanks-Morse horizontal pattern Type "Y" (Semi-Diesel) oil engine and the company's Type "Y" oil engines, style "V." These engines are made in sizes 10 hp. to 25 hp. horizontal, and 37½ hp. vertical. They burn nearly all of the grades of fuel oil available, and with almost as great economy as the Diesel type of engine. They are simpler in construction and in operation, and lower in first cost. They are adapted for pumping, lighting and power service, and particularly for isolated lighting service.